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1984 ANNUAL REVIEW

Special Report — March 1985

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MARKET DEVELOPMENTS

NATURAL URANIUM PRICES

Overview

The nuclear fuel market has been weakened in recent years by slack demand, inventory liquidations, a continuing excess of production over consumption of U_3O_8, and the expectation that new, low-cost uranium sources will be available as needed. Those trends continued during 1984, and the five-year trend toward lower natural uranium prices culminated in December's ten-year low for the Nuexco Exchange Value, at $15.25 per pound U_3O_8. Several developments were particularly noteworthy in a year characterized by the persistence of a buyer's market.

1. The US Department of Energy (USDOE) introduced the Utility Services enrichment contract (USEC). With the industry's return to what is essentially a requirements basis for enrichment, millions of pounds of uranium demand that had been created artificially by government-imposed, fixed-commitment enrichment contracts were removed from the market. Concessions obtained by some utilities on a case-by-case basis during negotiations for conversion to the USEC also made it easier to use their existing inventories to fill current requirements. The cumulative market effects of the USEC and inventory sales of enriched UF_6, quantified in Report 193 of September 1984, amounted to 120,000,000 pounds equivalent U_3O_8, through 1991. Now that utility requirements have been pushed farther out in time, the significant unfilled utility demand estimated to begin in the mid-to-late 1980s is unlikely to become apparent before the end of this decade.

2. Cancellations of nuclear power plants aggravated the already severe inventory overhang by adding substantial quantities of material to that already awaiting liquidation. Moreover, several utilities having delayed or canceled plants liquidated their stocks.

3. The discovery and extension of large, very-high-grade Canadian deposits reinforced the already strong market perception that uranium supplies will be plentiful well beyond the end of this century.

4. Production exceeded consumption by more than 40 percent despite a fifth consecutive year of price weakness. A number of US producers shut down their production operations and prepared to withdraw from the uranium business altogether.

5. Canada established itself as the world leader in uranium production. By almost doubling the output of the USA and South Africa, each of which produced about 15 percent of the world's uranium, Canadian producers accounted for almost 30 percent of 1984 production.

Supply, Demand and Prices

The Nuexco Exchange Value continued its decline from the $22-$24 level in the fourth quarter of 1983 to a temporary low of $17.00 in March 1984, thereby returning to the lowest level reached in 1983. Thereafter and through the third quarter of 1984 it remained at that approximate level.

Transactions amounting to almost four million pounds U_3O_8 equivalent had been made during March, effectively clearing the market of bargain-priced material. That event, coupled with the preoccupation of DOE's utility customers with their negotiation of terms and conditions for conversion to the USEC, caused the mid-year lull in market activity that led to six months of stable prices.

The relative stability of the second and third quarters was followed by a sharp decline during the fourth quarter. That decline was brought about by oversupply, discretionary buying patterns and aggressive competition among sellers for each opportunity. The Exchange Value ended the year at $15.25, its lowest point in ten years. Table 1 lists the Exchange Value for each month of 1984. Although price cutting had been the norm during the rest of the year, several producers declined to compete, so their material remained on the market throughout the year.

Supply figures during the first half of 1984 show utilities and producers to be represented almost equally. Unlike 1983, utilities dominated the demand category during 1984; after January, producer demand never accounted for more than 25 percent of all active spot and near-term demand. Supply was fairly evenly divided between U_3O_8 and UF_6 throughout the year. Table 2 lists the spot and near-term supply and demand for natural uranium and the supply-demand ratio for each month of 1984.

Many users filled current needs from stocks on hand, so unfilled current requirements were small. Demand was largely discretionary, in that buyers had the flexibility to buy and hold for future use or wait for better prices if they chose to do so. Buyers were predominantly European and US utilities.

Toward the end of 1984, record-low offering prices were needed to elicit any buyer interest, as expectations that the weak market would continue became more prevalent. On the selling side, the downward forces were led by large inventory holders seeking liquidation and producers driven to sell by considerations such as cash flow or strategic decisions to withdraw from the business. Enrichment tails assay swaps also released additional material into the market through brokers and trading companies.

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Table 1

1984 EXCHANGE VALUES, CONVERSION VALUES AND LOAN USE CHARGE RATES

Determined as of the Last Day of the Month	Published in Report Number	Exchange Value[1] (per lb. U_3O_8)	Conversion Value[2] (per lb. U in UF_6)	Loan Use Charge Rate[3] (per annum)
January	186	$20.50	$0.60	6%
February	187	$17.50	$0.30	6%
March	188	$17.00	$0.80	6%
April	189	$17.75	$0.80	6%
May	190	$17.75	$0.80	6%
June	191	$17.50	$0.00	6%
July	192	$17.50	$0.00	6%
August	193	$17.50	$0.80	6%
September	194	$17.50	$1.00	6%
October	195	$16.00	$1.00	6%
November	196	$15.50	$0.80	6%
December	197	$15.25	$0.80	6%
Annual Average		$17.27	$0.64	6%

[1]The *Exchange Value* is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month indicated.

[2]The *Conversion Value* is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month indicated.

[3]The *Loan Use Charge Rate* is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month indicated.

Table 2

1984 SPOT AND NEAR-TERM[1] SUPPLY AND DEMAND FOR NATURAL URANIUM
(Active inquiries as reported by Nuexco)

Determined as of the Last Day of the Month	Report Number	Uranium Supply[2] (Available for Sale)	Uranium Demand[2] (Inquiries to Purchase)	Spot and Near-Term Supply/Demand Ratio	Exchange Value (per lb. U_3O_8)
January	186	4.2	0.5	8.3	$20.50
February	187	5.9	1.3	4.5	$17.50
March	188	6.1	3.8	1.6	$17.00
April	189	7.4	3.4	2.2	$17.75
May	190	5.2	2.4	2.2	$17.75
June	191	4.3	1.9	2.2	$17.50
July	192	2.9	0.9	3.1	$17.50
August	193	5.1	1.1	4.6	$17.50
September	194	5.5	1.0	5.8	$17.50
October	195	5.5	1.3	4.3	$16.00
November	196	5.2	1.3	4.0	$15.50
December	197	3.6	1.3	2.9	$15.25
Annual Average		5.1	1.7	3.0	$17.27

[1]For delivery within one year.

[2]Millions of pounds U_3O_8 equivalent.

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Distress selling was an important factor in the weak market of 1984. Several utility sellers of large quantities of inventory entered the market during 1984 as a result of the continuation of general setbacks to nuclear power plant construction programs. Once an internal decision is made to cancel a nuclear plant or convert it to another fuel source, a utility will offer its material at whatever price is necessary to close a deal. Similarly, once a producer has decided to cease production or abandon the business altogether, its decisions to make or buy will be made strictly on the basis of economics.

Discretionary buyers moved in and out of the market sporadically during the year. Some utilities that had low carrying costs were especially active in this manner, buying to hold for future needs. Whenever firm utility demand emerged, it stimulated vigorous competition among sellers. In the absence of firm demand, distressed sellers reduced prices to stimulate buyers' interest. Those two sources of price cutting were the prominent selling themes of 1984. The outlook for 1985 is for more of the same.

While inventory sales by distressed sellers accounted for more than 10,000,000 pounds U_3O_8 equivalent during 1984, that is only a fraction of the material that remains available, as several utilities have a high probability of liquidating their inventories in 1985. Transactions during 1984 proved that even fabricated fuel, though not fungible, can be sold on the spot market.

Millions of pounds of excess uranium from producer stocks were on the market throughout 1984 at prices above then-current Exchange Values. Those producers, many having high production costs and a traditional view of the market, often were unwilling to reduce prices to make sales. However, enough material was offered by aggressive sellers to maintain the supply excess and weaken market prices. On the other hand, producers from western Canada competed actively and effectively in both the spot/near-term and longer-term markets.

The strengthening of the US dollar during the second half of the year improved the already solid competitive position of non-US sellers in general. That situation continued into 1985, as the dollar, which had been the world's weakest major currency only five years ago, in late February broke through two symbolic barriers: 10 French francs and 2,000 lire to the dollar; it almost reached parity with the pound sterling. As shown in Table 3, the dollar appreciated by 6 to 61 percent during 1984 against the currencies of selected producer and consumer nations. The combined effects of the Exchange Value's decline and the dollar's appreciation are shown in Table 4. The result was a general decline, except in the case of South Africa's 12-percent increase. In each case, the result depended on the combined effects of the answers to three questions.

1. Was that nation primarily a producer or a consumer of uranium?
2. How were its uranium activities divided between the spot/near-term market and the longer-term market?
3. How much of those activities were denominated in US dollars?

Two examples will illustrate the reasoning employed in the preceding paragraph. South Africa is almost exclusively a seller of uranium, rather than a buyer. Its contracts are almost all denominated in US dollars. Therefore, one could conclude that, all other factors being equal, South Africa's uranium revenues *in rand terms* increased by 12 percent in 1984. However, South Africa's uranium prices are based not on the Exchange Value (or other spot/near-term prices) but typically are negotiated annually. Those prices declined much less in dollar terms than did the Exchange Value, probably only 10 percent or less. Thus, the prices received for South Africa's uranium were affected much more by the dollar's 61-percent appreciation against the rand, so that their unit prices *in rand terms* were perhaps 50 percent higher in 1984 than in 1983.

On the other hand, US producers suffered substantially from both effects. The stronger dollar made US exports more costly, so that market segment was almost closed to US producers. A large fraction of US producers' 1984 deliveries was based on spot/near-term prices, so they were also affected severely by the 31-percent drop in Exchange Value during the year. Similar reasoning applied to each country's situation will give an understanding of the combined uranium price effects.

Conversion Value

Sellers of conversion in the secondary market found limited interest in their offers during most of 1984. The Conversion Value fluctuated throughout the year, reaching a peak of $1.00 during September and October. June and July produced the first zero value for conversion in the four years Nuexco has been reporting the Conversion Value. Holders of concentrates were able for a time to swap for natural UF_6 at no cost, so no value was placed on the conversion component of UF_6 in the market. In this very thin market, a clear willingness to buy or sell a significant quantity by only one market participant can have disproportionate effects on a given month's Conversion Value. Table 1 lists the Conversion Values for each month of 1984.

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Table 3

EXCHANGE RATES[1]
(Currency per US dollar)

Country (currency)	As of Dec. 30, 1983	As of Dec. 28, 1984	Percent Change
Australia (dollar)	1.11	1.20	+8
Belgium (comm. franc)	55.70	62.97	+13
Canada (dollar)	1.24	1.32	+6
Finland (markka)	5.83	6.52	+12
France (franc)	8.34	9.65	+16
FRG (mark)	2.73	3.15	+15
Italy (lira)	1661	1933	+16
Japan (yen)	232.05	250.10	+8
Netherlands (guilder)	3.07	3.55	+16
South Africa (rand)	1.22	1.97	+61
Spain (peseta)	157.55	172.95	+10
Sweden (krona)	8.01	8.96	+12
Switzerland (franc)	2.18	2.59	+19
UK (pound)	0.69	0.86	+25
US (dollar)	1.00	1.00	0

[1]Currency exchange rates from the *Wall Street Journal* of the date indicated.

Table 4

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES

Country (currency)	per lb. U_3O_8 in Concentrates		Percent Change
	Dec. 31, 1983	Dec. 31, 1984	
Australia (dollar)	24.50	18.37	-25
Belgium (comm. franc)	1,226	960.33	-22
Canada (dollar)	27.38	20.13	-26
Finland (markka)	128.21	99.48	-22
France (franc)	183.49	147.20	-20
FRG (mark)	59.96	47.99	-20
Italy (lira)	36,545	29,480	-19
Japan (yen)	5,106	3,814	-25
Netherlands (guilder)	67.46	54.08	-20
South Africa (rand)	26.80	29.99	+12
Spain (peseta)	3,466	2,638	-24
Sweden (krona)	176.14	136.53	-22
Switzerland (franc)	47.98	39.54	-18
UK (pound)	15.19	13.10	-14
US (dollar)	22.00	15.25	-31

[1]Currency exchange rates from the *Wall Street Journal* of the date indicated.

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Even the generally low secondary market prices for conversion failed to elicit much buyer interest. Active conversion demand was greater than zero in only four months during the year. Table 5 summarizes the secondary supply and demand for conversion services for each month of 1984.

Loan Use Charge Rate

The Loan Use Charge Rate did not change during 1984, staying at 6 percent per annum; Nuexco was aware of only a few prospective buyers during the entire year. A number of potential lenders continued to offer a relatively large and stable supply. Table 5 lists the supply and demand for natural uranium loans. Most potential lenders have been utilities holding large stockpiles of unneeded material, much of it natural UF_6. Potential borrowers seemed to lose interest completely in taking loans when the downturn in spot and near-term market prices commenced in the final quarter of 1983.

Analysis of Uranium Sales Transactions

Table 6 shows a breakdown of 1984 natural uranium sales transactions listed in the Nuexco Monthly Report, as indicated by the month in which they were reported. The total of 55 transactions involved a quantity of 36.1 million pounds U_3O_8 equivalent; forty-five transactions involving about 12.8 million pounds (35 percent by weight) called for spot or near-term delivery and were made up of 56 percent natural UF_6 (19 transactions) and 44 percent concentrates (26 transactions). Ten transactions accounted for the remaining 23.3 million pounds (65 percent), which were sold under longer-term contracts; six U_3O_8 transactions accounted for 35 percent and four UF_6 transactions, all by Canadian producers, accounted for the remaining 65 percent (15.2 million pounds U_3O_8 equivalent). The foregoing amounts incorporate some data refinements received since the transactions were first published.

The 1984 uranium market developed somewhat more conventionally than in 1983; utilities were the primary buyers, and producers the major sellers. Utility buyers increased their market share (as indicated by amount of material involved in transactions) to 94 percent in 1984 from 66 percent in 1983. Producer buyers accounted for much less of the market, falling to 2 percent in 1984 from 11 percent in 1983. Other buyers—government entities,

Table 5

ACTIVE SUPPLY AND DEMAND FOR SECONDARY MARKET CONVERSION[1] AND NATURAL URANIUM LOANS:[2] 1984
(Active inquiries as reported by Nuexco)

Determined as of the Last Day of the Month	Report Number	Conversion Supply (millions of pounds U as UF_6)	Conversion Demand	Loan Supply (millions of pounds U_3O_8 equivalent)	Loan Demand	Exchange Value (per lb. U_3O_8)
January	186	3.2	0.3	3.0	0.0	$20.50
February	187	3.1	0.2	3.0	0.0	$17.50
March	188	3.6	0.1	3.5	0.0	$17.00
April	189	2.9	0.0	5.5	0.3	$17.75
May	190	2.9	0.0	7.0	0.8	$17.75
June	191	2.8	0.0	7.1	0.5	$17.50
July	192	2.8	0.0	7.1	0.0	$17.50
August	193	2.8	0.8	0.0	0.0	$17.50
September	194	2.8	0.0	0.0	0.0	$17.50
October	195	1.2	0.0	0.0	0.0	$16.00
November	196	1.2	0.0	0.0	0.0	$15.50
December	197	1.0	0.0	0.0	0.0	$15.25

[1]For delivery within three years.
[2]Data refer to spot and near-term demand, i.e., material to be delivered to the *borrower* within one year.
[3]Involving competitive price, terms and other conditions.

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trading companies, etc.—accounted for only 10 percent of material in 1984 transactions, down from 23 percent in 1983.

On the sellers' side, uranium producers became the dominant suppliers with 73 percent of the transactions, up from 44 percent in 1983. However, inventory redistribution continued to the extent that sales by non-producers represent inventory sales. Utility sellers as a portion of the market increased from 6 percent in 1983 to 7 percent in 1984. The third category, other sellers, amounted to 20 percent in 1984, down from 50 percent in the previous year. In 1985, inventory redistribution, a process that is necessary before market stability can be reached, is expected to continue.

Table 6

TRANSACTIONS: NATURAL URANIUM SALES[1] REPORTED BY NUEXCO DURING 1984
(Millions of pounds U_3O_8 equivalent)

SELLERS		BUYERS		
		Utilities	Producers	Others
Utilities	Spot/Near-term	1.64	.04	.71
	Long-term	0	0	0
Producers	Spot/Near-term	5.18	.82	.58
	Long-term	19.70	0	0
Others	Spot/Near-term	3.75	.05	0
	Long-term	3.65	0	0

[1] Does not include transactions which fall into one or more of the following categories:

a. Transactions which took place in 1983 but were reported in 1984;
b. Transactions which involved enriched uranium or fabricated fuel;
c. Transactions that Nuexco did not know about;
d. Transactions that Nuexco was aware of but chose not to report, either to protect client confidentiality or because Nuexco was not satisfied with the reliability of our information; and/or
e. A negotiation which has not advanced to such a degree that Nuexco would judge it a completed transaction. Because of the subjective nature of Nuexco judgments, some pending negotiations may have been reported as transactions only to fall through later. In these cases, the transaction was omitted from this table.
f. Finally, a transaction is not a delivery of material, and options or new deliveries from old transactions are not regarded as transactions.

The reporting of nuclear fuel market transactions is subject to numerous limitations. Among them, the following probably are the most restrictive.

1. Transactions that Nuexco did not know about, or those in which insufficient information could be reliably ascertained, are not reported.

2. Nuexco chooses not to report certain transactions (or certain information about a published transaction) if the reporting of such information would jeopardize client confidentiality.

3. Nuexco does not define a transaction to mean a delivery of material, nor are options or new deliveries from old contracts regarded as transactions. Rather, a transaction is a new agreement to purchase, loan, etc.

4. Because of the subjective nature of Nuexco's judgments, some agreements may be reported as transactions only to fall through later. A negotiation may be judged a transaction as soon as the parties verbally agree, or as late as contract signing, or even later, depending on Nuexco's confidence in the completion of delivery and payment.

5. The above analysis of 1984 transactions also did not include those which took place in 1983 but were reported in 1984, as well as transactions involving enriched uranium or fabricated fuel.

Transaction Value

Transactions included in the Transaction Value calculation are, in general, a subset of those listed under the category "Uranium Sales" in the *Current Market Data* section of each Report. Historically the Transaction Value, which is a weighted average of prices paid for natural uranium in spot and near-term transactions of immediately preceding months, has trailed the Exchange Value. This was true in the first four months of 1984, as the Transaction Value calculation retained transactions from late 1983, exchanged at higher prices. The earlier transactions were required in order to meet the minimum two million pounds of U_3O_8 or equivalent UF_6 stipulated in the Transaction Value parameters. Large quantities exchanged in the middle months of 1984 (at low prices) pushed the old quantities out of the calculation, and the Transaction Value fell below the Exchange Value for a five-month period. The closing months of 1984 exhibited a steep decline in the Exchange Value, and the Transaction Value also fell, but at a slower rate more characteristic of the gap between the two values. Table 7 lists the Transaction Value and its associated parameters for each month of 1984.

Thirty-three 1984 transactions were used in the Transaction Value calculations and their total quantity was 8.4

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million pounds equivalent U_3O_8. The weighted average price in those transactions was $16.73.

Loans and Secondary Market Conversion Transactions

Table 8 lists the four 1984 secondary market conversion transactions Nuexco reported. No uranium loans were reported in 1984; the relative ease of obtaining material at low prices has dampened the loan market considerably. Three of the four conversion transactions took place at prices well below the current Nuexco Conversion Value, illustrating the discretionary aspect of 1984 conversion demand.

Table 7 .

1984 TRANSACTION VALUES[1]
(and associated parameters)

Determined as of the Last Day of the Month	Report Number	Transaction Value (per lb. U_3O_8)	Millions of Pounds	Number of Transactions	Number of Months
January	186	$23.05	2.9	17	7
February	187	$22.50	2.0	13	7
March	188	$19.25	3.2	12	5
April	189	$17.90	2.5	10	5
May	190	$17.00	3.8	17	3
June	191	$16.50	5.4	18	4
July	192	$16.60	3.9	10	4
August	193	$16.40	3.9	10	4
September	194	$16.55	4.3	12	5
October	195	$16.05	2.7	10	5
November	196	$15.90	3.5	11	6
December	197	$15.90	3.7	16	7

[1]The *Transaction Value* is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
b. At least ten transactions;
c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.
The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

Table 8

1984 SECONDARY MARKET CONVERSION TRANSACTIONS REPORTED BY NUEXCO

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
2686	1984	101-300	100	US Producer	US Utility	
2685	1984	50-100	38	European Entity	US Utility	
2672	1984-5	601-1,000	73	US Utility	European Utility	Deconversion and origin swap.
3245	1985	101-300	63	US Producer	US Utility	Not an arm's length transaction.

No Uranium Loans were reported by Nuexco in 1984.

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SECONDARY MARKET ENRICHMENT SERVICES

Introduction

The secondary market for enrichment services was dominated during 1984 by reactions to the USEC, first by buyers and sellers, and then by DOE's competitors. SWU prices remained relatively stable throughout the year, despite the widespread repercussions caused by the USEC; two were especially important.

1. Eurodif and Urenco responded to the USEC with new offers. One type was aimed at utilities that had signed the USEC, but still had unfilled requirements due to their having committed for less than 100 percent of requirements. The other type of long-term contract was aimed at those utilities that had not signed the USEC.

2. The USEC eliminated millions of pounds of artificial uranium demand, and three US producers countered with a lawsuit against DOE, charging it with failing to maintain the viability of the US uranium production industry, among other allegations, and seeking to have the USEC invalidated.

Pricing Trends

Table 9 shows the Nuexco SWU Values for each month of 1984. By March, the market for FY84 DOE SWU seemingly had come to a close. Prices dropped from $115 in January to approximately $110 in February as sellers cut prices to compete for the diminishing demand.

In Report 188 (April 1984), Nuexco began publishing a FY85 DOE SWU Value. Like the utilities active in the late FY84 market, most active FY85 buyers consisted of utilities who had committed to the USEC, or recognized early that they would convert, and moved to secure SWUs at the lower prices available at the time. As the middle of the year approached, prices fell to an annual low of $105 per SWU during June and July, largely because of two events.

1. One seller entered the market intent on liquidating a large quantity of excess inventory and pursued particularly aggressive pricing policies.

2. In addition, it became possible for DOE customers retaining their fixed-commitment contracts (AFCs) to assign excess commitments to others that had notified DOE of their intent to convert to the USEC, thereby avoiding purchases at the higher AFC price. Thus, at a fixed discount, the net price through assignment was lower than the net price through a sale, permitting lower SWU prices for a short period of time.

Prices recovered toward the end of the year as low-price sellers disappeared, and the market stagnated. Last-minute sellers then began to compete aggressively for the little

Table 9

1984 SWU VALUES

Determined as of the Last Day of the Month	Report Number	DOE Origin FY84 Delivery	DOE Origin FY85 Delivery	DOE Origin FY86 Delivery[1]	Non-DOE Origin delivery within 15 Months	Non-DOE Origin delivery in CY86
January	186	$105	—	—	$85	—
February	187	$100	—	—	$83	—
March	188	—	$100	—	$80	—
April	189	—	$105	—	$80	—
May	190	—	$105	—	$80	—
June	191	—	$ 95	—	$80	—
July	192	—	$ 95	—	$85	—
August	193	—	$100	—	$85	—
September	194	—	$115	$20	$90	$98
October	195	—	$115	$20	$90	$98
November	196	—	$115	$15	$85	$95
December	197	—	$112	$15	$80	$90

[1]Discount from USEC base price on delivery.

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remaining demand. A small market for FY86 DOE SWU also emerged, but remained quiet as discounts ranging from $15 to $20 per SWU developed. Most FY86 buyers and sellers appeared content to wait for DOE's FY86 price announcement, now expected in April of 1985.

Throughout most of 1984, Nuexco published its SWU Values on the basis of an 0.2 weight-percent (w/o) tails assay. During the year, however, the nature of the market changed due largely to the terms of the USEC contract. Few, if any, buyers opted to purchase SWU at tails assays different from 0.3 w/o. Thus, in Report 194 (October 1984), Nuexco changed the derivation of its SWU Values to include an 0.3 w/o tails assay. (For this review of SWU prices, all values are presented on the basis of an 0.3 w/o tails assay.)

In the past, values for non-DOE origin SWUs have been highly responsive to DOE SWU Values, mainly because DOE and non-DOE SWU sellers competed for the same market. In late March of 1984, DOE established a policy that removed this dependency and further separated the two markets. The certification policy, instituted to stop displacement-type transactions, redefined the market such that the Nuexco DOE-origin SWU Value became the value for DOE-origin, *certifiable* SWU, and the non-DOE origin SWU Value became the *Other* SWU Value, reflecting the price for DOE-origin, non-certifiable SWU as well as for non-DOE origin SWU. The Other SWU Value for delivery within fifteen months remained stable during the first 10 months of the year, fluctuating between $90 and $95 per SWU. It fell to $85 in November and $80 in December as sellers became particularly aggressive.

As the market for calendar year 1986 delivery of Other SWUs developed, Nuexco began publishing in Report 194 (October 1984) a corresponding SWU Value. That value ranged from $90 to $98 per SWU over the last few months of the year, and followed the same general trend as the nearer-term value. The difference between the two values reflected the carrying costs associated with purchasing in 1985 for use in 1986.

Issues Arising from the USEC

In the months following the issuance of the USEC, it became apparent that the contract was popular among the vast majority of DOE's customers. Contract negotiations took place throughout the summer, and by the time all of the contract conversions were completed, DOE had modified the conversion terms to provide concessions to each class of customer. As a result, the degree of contract conversion exceeded even DOE's expectations. The only area where a significant number of customers did not convert was in Europe. Those defections were not unexpected, however, since both Urenco and Eurodif are multinational organizations.

The secondary market adjusted quickly to the new contract. The major change in market dynamics stemmed from the requirement that SWU used to offset deliveries under the USEC must be certifiable as excess through FY86 by the buyer (who consequently must obtain a similar warranty from the seller). This requirement amounted to a natural evolution of a similar requirement under the Interim Sales Contracts. DOE used the certification policy to thwart displacement transactions, in which DOE SWU were sold and replaced by lower-priced SWU of non-DOE origin. The buyer also had to certify that the proposed transaction did not allow a related displacement transaction to occur. Thus, in a number of cases, DOE was able to halt secondary market transactions by ruling that the SWUs were not certifiable, regardless of whether the buyers or sellers were willing to make such certification. DOE appears to be continuing this tactic in early 1985.

The issues surrounding the USEC were much more predominant outside of DOE's customer bases. In December 1984, three US uranium producers (Western Nuclear, Energy Fuels and Uranium Resources) filed suit against DOE on five counts. These producers contended that the plight of the US uranium industry was due to DOE actions and inactions. One of the counts charged that DOE unlawfully issued the USEC by not complying with the notice-and-comment requirements specified under the Administrative Procedures Act. Another count charged that DOE was unwilling to take measures to ensure the viability of the US uranium production industry as specified in the Atomic Energy Act. The suit contends therefore that the USEC should be invalidated. These three producers do not stand alone in their opinion that DOE mishandled the new contract.

Also in December, the General Accounting Office (GAO) released the results of its investigation into DOE's actions surrounding the issuance of the USEC. Among the major points of the GAO study are:

1. The guaranteed ceiling price in the USEC either conflicts with or is not specifically authorized in the present enrichment criteria;

2. Certain aspects of the enrichment program do fall under the requirements of the Administrative Procedures Act, and thus there may be some basis for the contentions of the plaintiffs in the suit mentioned above;

3. While it is accepted practice to write down non-producing assets, the amount of write-off of the gaseous

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diffusion plants DOE used in calculating the $135 per SWU price may be unlawful and inappropriate. (It has been recognized for some time that DOE can manipulate its accounting practices to attain certain SWU pricing goals.)

Thus, while the legality of DOE's actions came under closer scrutiny in 1984, DOE is now pursuing yet another program that will reduce prices on certain SWU to $90.

DOE's actions also invited criticism in terms of business strategy. The USEC was introduced under the new "businesslike" philosophy that DOE heralded during 1984. DOE attempted to foster a business image rather than that of a government service organization. In August 1984, Nuexco's J. Robert Wolcott gave testimony before the Tri-committee Advisory Panel on Uranium Enrichment. Below are some of his reflections capturing the nature of the business vs. government service debate. A more detailed discussion of Mr. Wolcott's comments may be found in Report 196 (December 1984).

1. **Full Cost Recovery**—Using a ten-year rolling pricing campaign, DOE arrived at a price of $135 per SWU. If every SWU sold in that period were sold at $135, in constant dollars, DOE would break even. At the same time, DOE shows SWU prices constantly decreasing over the same period. The $135 price is only a *ceiling* in this case. Reconciling these two sets of data, it appears DOE would *lose* $3 billion over the period.

2. **Market Forecast**—Comparing DOE's sales forecast (used in their pricing campaign) with demand over the same period, DOE must supply 70 percent of the world enrichment market to attain its goal. DOE's international market share would have to *increase* during a period when it is actually *decreasing* due to the forces of nationalism. DOE's forecasts have historically been optimistic, but is a continuation of this practice prudent for a "business"?

3. **DOE's April 1984 Pricing Campaign**—Comparing annual projected costs with revenues, DOE shows six years of losses before the first annual gain is achieved. In fact, through FY90, a cumulative loss of $3.4 billion is realized. Only after costs approach the $100 per SWU level (in constant dollars) can DOE recoup these losses. Furthermore, it is difficult to imagine costs approaching that level in the wake of developing new technologies which optimistically would be deployed in the mid-1990s.

In summary, DOE's actions, coupled with industry and government responses, do not support the claim that the US enrichment enterprise is moving in a more businesslike direction.

[1] Eurodif announced in late 1984 that it will offer two new enrichment contracts. One, the Flexible Services Contract, is a requirements-type contract which can be exercised by utilities wishing to fill the remaining 30 percent of requirements allowed under the USEC. Urenco offers a similar contract. DOE's incentive pricing campaign initiated in early 1985 is aimed at the same market. Eurodif also introduced a new long-term contract which will succeed its current contracts.

1984 Secondary Market Enrichment Transactions

Table 10 lists data regarding secondary market SWU transactions reported by Nuexco in 1984. The analysis includes transactions of which Nuexco is aware and possesses sufficiently complete data, and may include transactions which have been subsequently updated based on new information. A total of approximately 6.7 million SWUs were sold in 56 transactions. Approximately 65 percent of all transactions involved DOE-origin SWU, while the other 35 percent involved SWUs of non-DOE origin. 36 percent (20) of the total number of transactions involved FY84 deliveries, but the quantity of SWUs involved in those transactions, 1.5 million, was only 22 percent of the total quantity. Similarly, while 36 percent of the transactions involved FY85 deliveries, the number of FY85 SWUs sold (1.6 million) accounted for 24 percent of the total. The greatest quantity of SWUs, 52 percent (3.5 million), were sold for delivery in FY86 and beyond, also accounting for 36 percent of the transactions. Most of these sales entailed multiple annual deliveries. Four of the transactions involved deliveries in more than one of the three delivery period categories.

Table 10

1984 SECONDARY MARKET SWU TRANSACTIONS[1]

Delivery Period	Number of Transactions	Millions of SWUs
FY84	20	1.5
FY85	20	1.6
FY86 and beyond	20	3.5
All[2]	56[3]	6.7

[1] Only includes transactions which occurred in 1984. Does not include transactions for which Nuexco has incomplete or unreliable data. Some transactions may have been updated after original publishing.
[2] Approximately 65 percent of all transactions involved DOE origin SWUs, while the other 35 percent involved SWUs of non-DOE origin.
[3] Note that four transactions involved deliveries in more than one of the three delivery period categories.

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WORLD URANIUM PRODUCTION

In 1984, world uranium production increased 5 percent over the 1983 figure to almost exactly 100 million pounds U_3O_8. Substantial production increases in Australia and Canada offset the large decline in US output. France and Africa also produced slightly less in 1984. A comparison of Nuexco production estimates for 1983 and 1984 is presented in Table 11.

Table 11

1984 WORLD URANIUM PRODUCTION[1]
(Millions of pounds U_3O_8)

Country	1983	1984	Percent Change
Australia	8.4	10.3	+23
Canada	18.6	29.1	+56
France	8.5	8.2	- 4
South Africa[2]	15.8	15.0	- 5
Other Africa	21.2	20.4	- 4
Other	1.7	1.7	0
Subtotal	74.2	84.7	+14
United States	21.2	15.6	-26
TOTAL	95.4	100.3	+ 5

[1]Nuexco estimates.
[2]Includes estimate for Palabora Mining Company.

Australia's 1984 production increase came from greater output at Energy Resources of Australia's (ERA) Ranger mine. A higher rate of production compensated for a lower than normal output in 1983 that had been caused by several months unexpected shutdown. While Ranger is now producing at normal levels, the completion of Queensland Mines, Ltd. production at Nabarlek means that Australian production cannot be expected to equal its 1982 peak of 11,600,000 pounds U_3O_8 without new capacity.

Canadian production increased as Key Lake Mining Corp. reached its monthly capacity of 1 million pounds, finishing the year with 10.4 million pounds total output. Canada produced more uranium than any other country in the world and will continue to do so for the foreseeable future.

The decline in US production continued the trend that began in 1981. With the closure of Kerr McGee's Quivira Mining Company mine and mill at Grants, New Mexico, announced in January 1985, that downward trend is certain to continue through 1985. Not all US producers are reducing production; phosphate producers are in some cases increasing uranium output due to the strength of the fertilizer industry. However, the conventional operations have been hit the hardest. Of the ten conventional mills operating in 1985, about half will continue producing through 1986.

As indicated in Table 12, Nuexco projects world uranium production in 1985 will decline to approximately 94,000,000 pounds. Australian production will be almost unchanged from 1984; South African output will drop slightly as two announced mine closures take effect, and the USA will continue its downward slide. As expected, Canada will represent the only encouraging sign. Canadian production will increase slightly, with the Key Lake project operating at full capacity for an entire year.

It is worth noting that while estimates made at the end of each year are reasonably accurate for their intended purpose, they are far from perfect. Thus, Nuexco updates its estimates of historical production from time to time. Nuexco's latest estimates of historical uranium production for 1980 to 1984 (and forecast for 1985) are presented in Table 13. We welcome any additional refinements to our data.

Table 12

1985 WORLD PRODUCTION FORECAST
(Millions of pounds U_3O_8)

Country	1984[1]	1985	Percent Change
Australia	10.3	9.8	- 5
Canada	29.1	29.9	+ 3
France	8.2	8.0	- 2
South Africa[2]	15.0	13.7	- 9
Other Africa	20.4	19.5	- 4
Other	1.7	2.4	+41
Subtotal	84.7	83.3	- 2
United States	15.6	10.5	-33
TOTAL	100.3	93.8	- 6

[1]Nuexco estimates.
[2]Includes estimate for Palabora Mining Company.

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Table 13

WORLD[1] URANIUM PRODUCTION 1980-1985[2]
(Millions of pounds equivalent U_3O_8)

Country	1980	1981	1982	1983	1984	1985
Australia	4.1	8.1	11.6	8.4	10.3	9.8
Canada	18.6	20.1	21.0	18.6	29.1	29.9
France	6.8	6.6	7.8	8.5	8.2	8.0
South Africa	16.0	15.9	15.1	15.8	15.0	13.7
Other Africa	23.9	24.3	23.4	21.2	20.4	19.5
Other Nations	1.8	1.1	1.9	1.7	1.7	2.4
USA	43.7	38.7	26.8	21.2	15.6	10.5
Total	114.9	114.8	107.7	95.3	100.3	93.8
(rounded)	115	115	108	95	100	94

[1]Outside Soviet bloc areas.
[2]1980-1984 data are Nuexco's best estimates. 1985 data are Nuexco forecasts.

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AUSTRALIA

Political Developments

Governmental policy decisions once again played the dominant role in Australia's uranium production industry in 1984. The ruling Australian Labor Party (ALP) continued to administer policies consistent with the party's platform, which at one time called for the cessation of uranium mining. The government moderated its stance somewhat by allowing production at the Nabarlek and Ranger mines to continue; it also recognized the economic importance of the copper/uranium deposit at Olympic Dam (Roxby Downs) by allowing its development to proceed. However, in July 1984 the ALP essentially reaffirmed the uranium policy that it had tentatively established in November 1983. Although the policy allowed the continuation of production at Ranger (Nabarlek has ceased operations), it included the following restrictions:

1. It prohibits the mining of any undeveloped uranium properties other than Olympic Dam;
2. It forbids the export of Australian uranium to France as long as the French military performs nuclear weapons testing in the Pacific;
3. Finally, it prohibits the construction of nuclear power plants or fuel cycle facilities in Australia.

The ALP's action at the July party convention came as somewhat of a disappointment, especially insofar as it ran counter to several strong recommendations to relax somewhat its stringent policy. The Australian Science and Technology Council (ASTEC), in a May 1984 report, strongly advocated a more active role for Australia in the international nuclear fuel cycle. The report followed an inquiry, entitled "Examination of the Issues Related to Australia's Role in the Nuclear Fuel Cycle," commissioned by the government to assess Australia's safeguards arrangements and other sensitive fuel cycle issues. The report argued that greater involvement will place Australia in a better position to influence the non-proliferation of nuclear weapons, as well as the safe use of nuclear power. It also suggested that Australia consider developing domestic programs for uranium enrichment and spent fuel reprocessing in addition to expanding research on radioactive waste management.

In addition to the ASTEC report, several key government ministers argued that the ALP policy lessens Australia's ability to influence international nuclear issues, and harms relations with important European trading partners. Nevertheless, the ALP firmly reiterated its earlier prohibition of mining of undeveloped uranium properties (except Roxby Downs), uranium exports to France, and development of nuclear power plants or fuel cycle facilities.

The government dealt another setback to Australia's already reeling uranium industry in September, when the previously declared ban on uranium exports to France made its first commercial impact. Although the ban technically had been in effect since early 1983, it had been moot until Queensland Mines, Ltd. (QML) was due to make new shipments under a contract with Electricite de France (EDF). The contract, negotiated in 1981, called for the delivery of 6.8 million pounds U_3O_8 between 1982 and 1988. Without EDF's consent to void the contract, QML would have had to declare force majeure or become liable for breach of contract. Shortly thereafter the Australian government intervened, announcing that it had agreed to purchase 1.6 million pounds U_3O_8 over the next two years. It agreed to purchase each of the next eight shipments at the original delivery price. Based on an Australian floor price of approximately US $31, the compensation would approach US $50 million over the next two years. The purchase relieved the ALP of pressure from the uranium producers for the time being, until Australia's uranium export policies can be modified or circumvented.

Olympic Dam Project

Despite these uncertainties, the joint venture partners developing the Olympic Dam (Roxby Downs) project are optimistic. The partners, Western Mining Co. (WMC) and BP Australia, launched a full-scale feasibility study (A$150 million) in late 1984. The Chairman of WMC announced that full production would be achieved in stages because of limited uranium marketing opportunities before 1990. The study, scheduled for completion in early 1985, also indicated initial production of the Roxby Downs ore body would concentrate on high-grade gold areas. The first stage would be designed to treat ore averaging three percent copper, 3.3 pounds U_3O_8 and 0.4 grams of gold per ton of ore. Annual yield would include 2,000 metric tons U_3O_8.

The impact of the feasibility study and subsequent pilot plant operation may have been underestimated by observers, because the plant would constitute almost a complete first stage. The significance of the deposit lies not only in its immensity, estimated at 2,800 million pounds U_3O_8 (at an average grade of 0.06 percent) in addition to vast copper reserves, but also in its diversity. With the emphasis on co-product production, the partners hope to begin production in the late 1980s.

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AUSTRALIA

Production Results

Overall Australian production increased 23 percent over 1983 production to 10.3 million pounds, second only to Canada in percentage increase. The 1.9-million-pound U_3O_8 increase can be attributed to greater output at ERA's (Energy Resources of Australia) Ranger mine, which reported production of 7.6 million pounds U_3O_8. A higher rate of production compensated for the 1983 output, which was lower than normal. Nuexco does not expect Ranger to meet this level of production in 1985. Queensland Mines Ltd., operator of the Nabarlek mine, continued production at its 1983 level, reporting production of 2.8 million pounds U_3O_8. The government purchase of the EDF material allowed production to continue at normal rates.

ERA recently expanded its market share by signing long-term supply contracts with two US utilities. American Electric Power Co., in a renegotiation of a previous contract, and Pennsylvania Power and Light Co. signed contracts reportedly totalling 6.5 million pounds U_3O_8. Deliveries are scheduled to begin late in the decade, although Nuexco's information indicates that the contracts are organized in such a way to allow considerable delivery flexibility. It is unlikely that US utilities would agree to terms that would require them to buy large amounts of material at prices substantially higher than spot market prices. Therefore, the agreements probably are structured as call options, which would allow the utilities to call on ERA for delivery at discounts from market price if and when the Australian floor price falls below market price. Accordingly, the contracts probably do not require the utilities to take and pay for any meaningful quantities while the market price is below the Australian floor.

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CANADA

Uranium Production

Canada led the world in uranium output in 1984 as production totaled 29.1 million pounds U_3O_8, compared to 18.6 million pounds in 1983. The 56-percent increase came about as a result of a full year's production from the Key Lake project in northern Saskatchewan, which began milling ore in October 1983, and the higher production achieved at the Stanleigh Mine at Elliot Lake, Ontario, which had been restarted in late 1983. The Key Lake Mining Company, owned by SMDC (50 percent), Uranerz Exploration and Mining (33.3 percent) and Eldor Resources Ltd. (16.7 percent), produced 10.4 million pounds U_3O_8 in 1984, up from 1.6 million pounds in 1983. Stanleigh, operated by Rio Algom Ltd., produced approximately one million pounds U_3O_8, double its 1983 output.

The Key Lake project became the world's largest uranium production center in 1984 (as measured by output, rather than ore milling capacity). If 1985 production levels (currently one million pounds per month) are maintained, the plant's design annual capacity of 12 million pounds U_3O_8 will be achieved as scheduled. Production can be sustained at that level for the next 12 to 15 years.

Almost continuous exploratory drilling at the Cigar Lake deposit in 1984 more than doubled preliminary estimates of reserves. The deposit is divided into two principal areas of mineralization. The main ore deposit contains reserves of 285 million pounds U_3O_8 at an average grade of 14 percent U_3O_8 (12 percent elemental uranium). A narrowing extension of ore to the west, referred to as the tail, contains an estimated 100 to 150 million pounds at an average grade of 4.7 percent U_3O_8.

Cogema Canada Ltd., the operator of the project, will continue evaluation through 1985 and beyond. Exploration drilling currently is in progress along zones thought to have high potential for ore extensions. However, the primary drilling effort is concentrated within the main ore deposit in order to better establish reserve estimates and to develop a feasibility plan for ore recovery.

Ownership of the Cigar Lake development is divided between Cogema Canada (32.625 percent), Saskatchewan Mining Development Corporation (50.75 percent), Idemitsu Uranium Exploration Canada Ltd. (12.875 percent) and Corona Grande, a wholly-owned subsidiary of Cogema Canada (3.75 percent).

Nuclear Power Developments

There are currently fourteen Candu (pressurized heavy-water moderated and cooled) reactors in commercial operation in Canada, and nine reactors under construction or planned (Table 14). Two Ontario Hydro units entered commercial operation in 1984, and the utility shut down its Douglas Point reactor after 16 years of commercial operation. Ontario Hydro's Pickering Unit 6, a 515-MWe Candu, entered commercial operation in February 1984, and Bruce Unit 6, a 750-MWe Candu, entered commercial operation in September 1984. (In addition, the 515-MWe Pickering Unit 7 began commercial operation in January 1985.) The addition of the two units increased Canada's installed capacity from 7.0 gigawatts (GWe) in 1983 to 8.1 GWe in 1984. Ontario Hydro expects two more units to enter commercial operation in 1985, Bruce Unit 5 and Pickering Unit 8. These units, combined with the Pickering Unit 6 already in operation, will contribute to a 21-percent installed capacity increase in 1985. All reactors scheduled for commercial operation by 1992 are now under construction, with the exception of Point Lepreau Unit 2. Maritime Nuclear, an independent company created to establish the Point Lepreau Unit 2 project, invited contractor proposals in February 1984. A final decision is pending. The plant would be North America's first nuclear power plant on order since 1978. Maritime Nuclear is a government-owned company jointly formed by Atomic Energy of Canada and New Brunswick Electric Power Company.

Ontario Hydro's four Bruce units had an aggregate gross capacity factor of 94 percent in 1984. Bruce Unit 6, in commercial operation since September, had a 99-percent gross capacity factor for the fourth quarter. Bruce Unit 5, scheduled for commercial operation in April 1985, reached full power in January 1985, and may go into service ahead of the scheduled date. Ontario Hydro announced that the present workforce at Bruce Nuclear Power Development will be reduced by 40 percent over the next three years. The last two of the eight Bruce reactors will be completed by 1987, necessitating a layoff of nearly all of the 2,400 construction workers. By the time Units 7 and 8 are complete, the construction costs will have totaled C$10.5 billion for the eight plants.

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CANADA

Table 14

NUCLEAR POWER PLANTS IN CANADA

Unit	Utility	MWe (net)	Percent Complete	Commercial Operation Date
Commercial Operation				
Pickering 1	Ontario Hydro	515	100	Jul 1971
Pickering 2	Ontario Hydro	515	100	Dec 1971
Pickering 3	Ontario Hydro	515	100	Jun 1972
Pickering 4	Ontario Hydro	515	100	Jun 1973
Bruce 1	Ontario Hydro	740	100	Sep 1977
Bruce 2	Ontario Hydro	740	100	Sep 1977
Bruce 3	Ontario Hydro	740	100	Feb 1978
Bruce 4	Ontario Hydro	740	100	Jan 1979
Point Lepreau 1	New Brunswick EPC[1]	630	100	Jan 1983
Pickering 5	Ontario Hydro	515	100	May 1983
Gentilly 2	Hydro Quebec	640	100	Sep 1983
Pickering 6	Ontario Hydro	515	100	Feb 1984
Bruce 6	Ontario Hydro	750	100	Sep 1984
Pickering 7	Ontario Hydro	515	100	Jan 1985
Total		8,585		
Under Construction or Planned				
Bruce 5	Ontario Hydro	750	100	Apr 1985
Pickering 8	Ontario Hydro	515	95	Jul 1985
Bruce 7	Ontario Hydro	750	75	Apr 1986
Bruce 8	Ontario Hydro	750	60	Jan 1987
Darlington 2	Ontario Hydro	880	48	May 1988
Darlington 1	Ontario Hydro	880	23	Feb 1989
Darlington 3	Ontario Hydro	880	3	Nov 1991
Darlington 4	Ontario Hydro	880	1	Aug 1992
Point Lepreau 2	New Brunswick EPC	630	0	indefinite
Total		6,915		
Shut Down				
Douglas Point	Ontario Hydro	206	100	Sep 1968

[1]EPC = Electric Power Company.

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CENTRAL AFRICA

Niger

Output from Niger's uranium operations in 1984 was more than four percent less than the 1983 level. The two operating projects, Akouta and Arlit, produced 8.5 million pounds U_3O_8. Niger owns shares in all uranium projects through the state company Onarem (Office National des Ressources Minieres).

The underground mine at Akouta began production in mid-1978. The project currently produces slightly more than half of Niger's uranium. Cogema, which owns a 34-percent share and also operates the project, purchases approximately half the output. The mine also produces molybdenum as a by-product. The Arlit project, also operated by Cogema, involves open-pit mining of three related sedimentary deposits, with ore processed in two operating mill facilities. Shareholders include Onarem (33 percent), Cogema (27 percent) and Mokta (19.4 percent). The mine is located in the Agadez Basin, seven miles northeast of Akouta.

Both the Akouta and Arlit operations considered production cutbacks of up to 40 percent in 1984 due to reduced demand, but those cutbacks never took place, possibly because Niger delivers most of its material under long-term contracts and also because the country is heavily dependent on foreign trade. Uranium accounts for approximately 70 percent of Niger's export earnings. Although uranium accounted for 45 percent of the state budget in 1979, that figure has been declining and is expected to fall below 15 percent in 1985. Currently Onarem is waiving its option to purchase U_3O_8 from the two operations because of a lack of sufficient demand in the world market.

Gabon

Uranium production in Gabon declined ten percent in 1984, as total output fell to 2.3 million pounds U_3O_8. The Mounana mill, with a 440,000 metric ton annual capacity, processes all of the ore extracted from the nearby Oklo and Boyindzi deposits, containing average grades of 0.3 to 0.4 percent U_3O_8.

The owner of the project is Comuf (Compagnie des Mines d'Uranium de Franceville), a company organized under Gabonese laws for the purpose of mining the Franceville Basin uranium deposits. It leases a 1,150 square kilometer concession area originally granted by the government of Gabon to the French CEA (Commissariat a l'Energie Atomique). The Comuf ownership structure is comprised of several interests, including Compagnie Francaise Mokta (39 percent), which operates the project, the Gabonese state (24.8 percent), Cogema (18.8 percent), Pechiney (13 percent) and the Gabonese public (4.4 percent). Most Mounana production goes to Cogema, while other European and Japanese buyers receive shipments under short and medium-term contracts. Comuf, Cogema and Kepco (Korea Electric Power Company) are involved in exploration programs in and around the existing concession area.

Uranium accounts for approximately seven percent of Gabon's export earnings. The Transgabonais railway, currently under construction, will link the interior of the country to the coast, facilitating the transport of uranium, among other things.

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EUROPE

EUROPE

Introduction

The European Economic Community (EEC), in a recent forecast of energy growth, reported a provisional four-percent rise in member countries'[1] energy consumption in 1984. Nuclear power demonstrated the strongest growth compared to coal, hydro, and other sources, supplying about 26 percent of EEC electricity in 1984. The forecast indicates that nuclear power will provide 30 percent of member states' electricity needs in 1985. EEC figures predict member countries' nuclear capacity will reach 68 gigawatts (GWe) by the end of 1985, almost 50 percent higher than in 1983. Nuexco figures project approximately 64 GWe by the end of 1985.

These expectations are bolstered by the overall progress of nuclear power programs in Europe in 1984. For example, in France and Belgium, over half of the electricity was generated by nuclear power. Other countries, such as Sweden, the Federal Republic of Germany and the UK, continued to expand well-established programs. Switzerland and Italy further developed projects which were initiated in recent years. Despite the reemergence of the political debate over nuclear power, in which various public groups, political parties and governmental mandates attempted to limit its development or use, European nations in general advanced toward greater energy dependence on domestic nuclear sources.

AUSTRIA

The fate of the 720-MWe Zwentendorf BWR remained in doubt at the end of 1984. The finished plant has been idle since 1979, when the Austrian Parliament passed a law banning the use of nuclear power. The law was motivated by a popular vote against nuclear power some months before. Fierce opposition to the plant's operation still exists, and a two-thirds majority vote by members of Parliament is required to overturn the law. Even if the law were repealed, it would be politically necessary to hold a referendum on the plant's future.

The $700-million reactor now requires a staff of 40 to maintain it, at a cost of approximately $3 million per year. GKT (Gemeinschaftskernkraftwerk Tullnerfeld), the plant's utility, in 1984 began exploring ways to dispose of the Kraftwerk Union–built reactor. GKT has considered tearing down the unit and selling the spare parts, as well as transferring the entire plant to another country. Conversion of the plant to another fuel source has been deemed uneconomic by a study conducted for the trade ministry. Nevertheless, it is apparent that the electricity is needed, because Austrian dependence on electricity imports increased by 40 percent in 1983 and Austrian electricity imports surpassed exports for the first time.

The ruling Socialist-Liberal coalition will continue to debate the project. The Socialists have supported the project and in late 1984 announced they will make one last attempt to put the plant back into operation. The Liberals, under pressure from vocal environmental groups, said they would not accept any favorable mention of Zwentendorf in a national energy policy. Some resolution of the impasse is expected by the middle of 1985.

In related developments, GKT studied the possibilities of an arrangement whereby China would take spent fuel from the Zwentendorf reactor, seemingly solving the waste disposal issue which is a major obstacle to the unit's operation. Other nations had been approached with the idea of accepting Austria's spent fuel, but the process had met without success.

BELGIUM

Electricity consumption increased five percent in 1984, and nuclear power was responsible for 51 percent of Belgium's electricity. Coal, natural gas and nuclear power together generate almost 90 percent of the country's electricity. Five PWRs, with a capacity of 3,450 MWe, are in commercial operation, and two more are 95-percent completed. The units are divided between two plants: Tihange, near Liege, site of Tihange Units 1, 2 and 3, and Doel, near Antwerp, site of Doel Units 1, 2, 3 and 4. Tihange Unit 3 and Doel Unit 4 are 1,000-MWe PWRs scheduled for commercial operation in June 1985. Intercom, Belgium's largest utility, expects the government to decide soon regarding construction of an eighth unit. The Doel site has been considered as a possible location. Intercom hopes the French state utility Electricite de France (EDF) will also participate in the project, which probably will be a 1,300-MW reactor.

Following more than two years of negotiations, Belgium and France have agreed to cooperate on the construction of two 1,300-MWe nuclear reactors at Chooz, just across the French border. Under the agreement, Bel-

[1]The ten EEC member nations are Belgium, Denmark, France, FRG, Greece, Ireland, Italy, Luxembourg, Netherlands, and the UK.

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gian utilities will assume a 25-percent share in the two Chooz units, and 22.5 percent of the construction orders will go to Belgian industry. In return, French industry will receive 45 percent of the orders for the planned Belgian plant, and EDF will have the option of buying 50 percent of the plant's output. Under the accord, Belgian utilities have agreed to place construction orders for the new plant by March 1987. If electricity demand continues to grow, it is likely a decision to build an eighth unit will be forthcoming.

Synatom, the company which provides fuel cycle services to Belgian utilities, has sufficient enrichment coverage for all of Belgium's plants. A 50-percent partner (with the Belgian government) in Soben, which owns 11.1 percent of Eurodif, Synatom takes 100 percent of its enrichment needs from Eurodif. The two units nearing commercial operation also are covered by Eurodif enrichment.

FINLAND

This country has, in keeping with its relatively small population, a small nuclear power program. Two 445-MWe PWRs supplied by the USSR and two 660-MWe BWRs supplied by Sweden's Asea-Atom consistently have achieved capacity factors in the 80 to 90-percent range, and nuclear electricity generation per capita is the highest in the world. The plants supplied 41.1 percent of Finland's electricity in 1984.

Two utilities operate the four units. IVO (Imatran Voima Oy), a state-owned utility, operates the USSR-built units at Loviisa on the southeastern Baltic coast. TVO (Teollisuuden Voima Oy) operates the Asea-Atom BWRs at Olkiluoto on the southwestern coast. IVO orders its fuel each year from the USSR under a contract that stipulates the return of all spent fuel, relieving the utility of the responsibility for long-term waste storage. TVO purchases from the commercial uranium market. The USSR supplies both utilities with all of their enrichment requirements.

Electricity demand in Finland is forecast to grow approximately three percent per year until 1995. The current installed electrical capacity is expected to be sufficient until the early 1990s. Discussions regarding the possibility of a fifth nuclear unit in Finland took place throughout 1984, but a serious commitment was not announced. If it materializes, the project may involve a joint effort between the two utilities. Possible choices for the fifth reactor include a Soviet 1,000-MWe unit (VVER-1000), a Framatome 900-MWe PWR supplied by France, or another Swedish BWR. Site selection is likely to depend on the reactor origin; a Soviet unit probably would be built at the Loviisa site, while a French or Swedish unit would be built at Olkiluoto. However, in 1984 Finland initiated a reform of its nuclear legislation under which the national Parliament will have to approve construction of future nuclear plants. The legislative process could extend through 1985, so at present its effect on future units is unknown.

FRANCE

Nuclear Power

With the addition to the grid of seven new PWRs during 1984, Electricite de France (EDF) now produces approximately 65 percent of its total generation from nuclear power stations. The French state utility is currently operating 41 units at 12 stations, including two 1,300-MWe PWRs at the Paluel site in Normandy (Figure 1). Twenty additional units are currently under construction. By the end of 1990, EDF is scheduled to operate approximately 65 units at 21 stations in France, for a total net generating capacity of 61,403 MWe (Table 15). In addition, France concluded an agreement with Belgium in May to cooperate on the joint construction of the two-unit Chooz plant near the Belgian border. EDF issued plans in April for the decommissioning of three plants by 1986. One reactor, Marcoule Unit G3, was decommissioned in July 1984 after 25 years of service.

EDF and the US Electric Power Research Institute (EPRI) published late in 1984 the results of a joint study of plant construction programs in France and the USA which confirms EDF's successes.[1] Four principal conclusions of the study were:

1. The total capital costs for a French PWR average approximately 60 to 70 percent of the costs of a similarly sized unit in the USA.

2. Total craft labor requirements for a French unit may be as little as half those for a similar US plant. Requirements for non-craft labor are also much lower in France. (In the USA, non-craft labor costs are the fastest-rising component of base plant costs.)

3. While safety standards governing French plants are similar to those governing US plants, the regulatory structure is far more stable in France than in the USA.

[1] "A Comparative Review of US and French Power Plant Construction Projects," presented at the ANS/ENS International Conference in Washington, DC (November 1984).

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Figure 1

NUCLEAR PLANT SITES AND URANIUM PRODUCTION CENTERS IN FRANCE

[1]Chooz Unit A is a 300-MWe PWR. The Chooz plant is operated by SENA (Societe Nucleaire Franco-Belge des Ardennes).

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Table 15

NUCLEAR POWER STATIONS IN FRANCE

Unit	Net MWe	Type	COD	Percent Complete
Belleville 1*	1275	PWR	1988	50
Belleville 2*	1275	PWR	1988	40
Blayais 1	910	PWR	1981	100
Blayais 2	910	PWR	1983	100
Blayais 3	910	PWR	1983	100
Blayais 4	910	PWR	1983	100
Bugey 1	540	GCR	1972	100
Bugey 2	920	PWR	1979	100
Bugey 3	920	PWR	1979	100
Bugey 4	900	PWR	1979	100
Bugey 5	900	PWR	1980	100
Cattenom 1*	1265	PWR	1986	70
Cattenom 2*	1265	PWR	1987	55
Cattenom 3*	1265	PWR	1989	20
Cattenom 4*	1265	PWR	1990	5
Chinon A2	210	GCR	1965	100
Chinon A3	400	GCR	1967	100
Chinon B1	870	PWR	1984	100
Chinon B2	870	PWR	1984	100
Chinon B3*	870	PWR	1987	55
Chinon B4*	870	PWR	1988	40
Chooz A	310	PWR	1967	100
Chooz B1**	1400	PWR	1991	0
Chooz B2**	1400	PWR	1992	0
Creys-Malville*	1200	LMFBR	1985	95
Cruas 1	880	PWR	1983	100
Cruas 2	880	PWR	1984	100
Cruas 3	880	PWR	1984	100
Cruas 4	880	PWR	1984	100
Dampierre 1	890	PWR	1980	100
Dampierre 2	890	PWR	1981	100
Dampierre 3	890	PWR	1981	100
Dampierre 4	890	PWR	1981	100
Fessenheim 1	880	PWR	1977	100
Fessenheim 2	880	PWR	1978	100
Flamanville 1*	1290	PWR	1985	85
Flamanville 2*	1290	PWR	1987	65

See footnotes next page.

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Table 15

NUCLEAR POWER STATIONS IN FRANCE *(continued)*

Unit	Net MWe	Type	COD	Percent Complete
Golfech 1*	1275	PWR	1990	5
Golfech 2**	1275	PWR	1991	0
Gravelines B1	910	PWR	1980	100
Gravelines B2	910	PWR	1980	100
Gravelines B3	910	PWR	1981	100
Gravelines B4	910	PWR	1981	100
Gravelines C5	910	PWR	1984	100
Gravelines C6*	910	PWR	1985	85
Marcoule G2	40	GCR	1959	100
Marcoule G3[1]		GCR	1960	100
Phenix	233	LMFBR	1973	100
Monts d'Arce	70	GCHWR	1967	100
Nogent sur Seine 1*	1275	PWR	1988	40
Nogent sur Seine 2*	1275	PWR	1989	35
Paluel 1	1290	PWR	1984	100
Paluel 2	1290	PWR	1985	100
Paluel 3*	1290	PWR	1985	90
Paluel 4*	1290	PWR	1986	75
Penly 1*	1290	PWR	1990	5
Penly 2**	1290	PWR	1991	0
St. Alban 1*	1300	PWR	1985	90
St. Alban 2*	1300	PWR	1986	75
St. Laurent A1	460	GCR	1969	100
St. Laurent A2	515	GCR	1971	100
St. Laurent B1	880	PWR	1983	100
St. Laurent B2	880	PWR	1983	100
Tricastin 1	915	PWR	1980	100
Tricastin 2	915	PWR	1980	100
Tricastin 3	915	PWR	1981	100
Tricastin 4	915	PWR	1981	100
Total MWe	61,613			

* Unit under construction.
** Unit on order or planned.
[1] Marcoule Unit G3 was decommissioned in 1984. Chinon Unit A2 will be decommissioned in 1985.
[2] Chooz Unit A is owned and operated by SENA (Societe Nucleaire Franco-Belge des Ardennes).
[3] The Super-Phenix fast breeder reactor is being built by NERSA, a European consortium of which the principal shareholders are EDF (51 percent), ENEL (33 percent), and SBK (16 percent).

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4. Plant costs are reduced greatly when the utility employs standardized plant designs and units are replicated on site. EDF's successful record can be attributed in large measure to the use of one highly experienced vendor, Framatome, and to the practice of multiple-unit siting.

During 1984 EDF continued to export electricity to the Netherlands, Belgium, the FRG, Switzerland, Italy and Spain. Utilities in some of these countries have invested directly in French nuclear plants. Spain and Italy imported electricity from EDF in 1984 under agreements reached with Eurodif, in which both countries are shareholders. Eurodif is EDF's largest industrial customer; the four-unit Tricastin plant, located at the Eurodif site, supplies electricity to both Eurodif and Comurhex.

In another electricity-export project, the first phase of a grid link between France and the United Kingdom was completed during 1984 and is scheduled to begin transporting power this year. The joint venture between EDF and the Central Electricity Generating Board (CEGB) will eventually trade power between the countries. The 2,000-MW sealink connection under the English Channel is designed to take advantage of the difference in peak hours between France and the UK.

Fuel Supply

EDF receives most of its annual fuel requirements (over 15 million pounds U_3O_8 equivalent in 1984) from the state fuel cycle company Cogema or from EDF's own stockpile. The utility has also taken deliveries from non-French suppliers, including the Australian producer Queensland Mines Ltd. (QML). The Australian government decided in 1984 to prohibit QML from exporting concentrates to EDF in 1985, as a protest against the testing of nuclear weapons by the French military in the South Pacific. The action has had little effect on EDF's supply position.

Uranium Production

Cogema is an operator or leading shareholder of uranium mining operations in France, Central Africa, Western Canada and the USA (Figure 2). Those operations account for approximately 20 percent of the world's commercial uranium production. Many of the projects exploit relatively high-grade deposits as compared to most of the non-Canadian mines currently in operation in the world. Concentrates delivered from those operations during 1984 were sold under long-term marketing arrangements. Cogema delivers uranium to a number of Japanese and European utilities in addition to EDF. As the operator and a 36.4-percent shareholder in the Waterbury Lake joint venture in the Canadian province of Saskatchewan, Cogema continued during 1984 to explore the richest and most important uranium discovery in the world, the Cigar Lake deposit. (See the Canada section of this Report.)

Total Compagnie Minière, the largest private mining company in France, announced in 1984 that it would begin mining two new deposits in the Massif Central region during 1985. Total currently operates two of the six active mines in France, Mailhac and St. Pierre, and owns ten percent of Rossing Uranium Ltd. in Namibia. Production from Mailhac is sold directly to EDF. The St. Pierre mine will be decommissioned in 1985 as the mine life ends.

EDF may be forced to limit slightly its nuclear power production in order to burn coal. Under a March accord with the French coal board, Charbonnages de France (CDF), EDF is committed to take as much coal as CDF decides to offer it for the next five years. Prices are to be determined by average imported coal prices or the price of nuclear-generated electricity. The agreement anticipates that CDF will deliver approximately three million metric tons of coal per year between 1985 and 1988. It is unlikely the accord will alter EDF's current construction schedule, although it could have a longer-term impact.

EDF receives most of its enrichment requirements from Eurodif, and a small amount from non-French sources (DOE and the USSR); these enrichment supplies are managed jointly with Cogema. Cogema was especially active during 1984 as the marketing agent for Eurodif, of which it is the principal shareholder. The enrichment marketing strategy that Cogema began during 1983 was an important factor in DOE's decision to offer more favorable contract terms to its customers through the USEC. Two Swiss utilities terminated DOE contracts in 1984 to enlist with Cogema. Cogema also signed contracts during 1984 with one utility in the FRG, with the Swedish State Power Board, with a Japanese utility and some US utilities, and continues to pursue business in the USA and the Far East.

In late 1984, the Commissariat a l'Energie Atomique (CEA) chose three sites for consideration as a surface storage facility for low-level nuclear waste. Existing capacity at the La Hague facility is due to be filled by 1990. CEA will narrow the options to two locations by the end of 1985, and the plant is expected to become operational by 1990.

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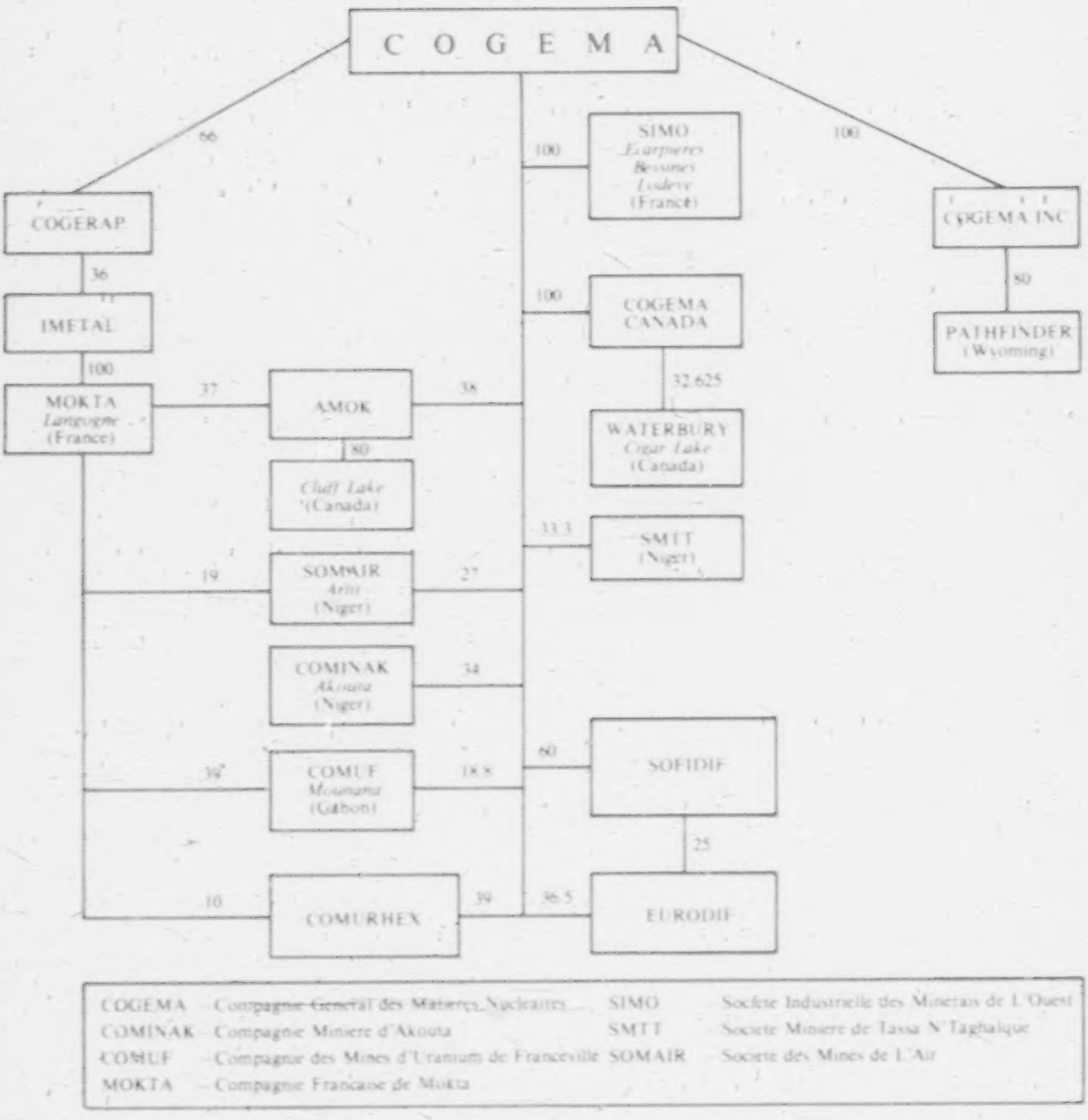

Figure 2

COGEMA OWNERSHIP INTERESTS IN WORLDWIDE URANIUM PROJECTS

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FEDERAL REPUBLIC OF GERMANY (FRG)

Electricity demand in the FRG rose 3.9 percent in 1984, and nuclear power was responsible for 27 percent of the electricity production, up from 21 percent in 1983. At the end of 1984, thirteen nuclear power units were in commercial service, with a total net installed capacity of 12,243 MWe (Table 16). Two new units entered commercial operation during the year: Kruemmel, a 1,260-MWe BWR located on the Elbe River near Hamburg (Figure 3), and the first unit of the Gundremmingen plant in Bavaria, a 1,244-MWe BWR. The Kruemmel unit is owned by HEW (Hamburgische Elektrizitaetswerke) and NWK (Nordwestdeutsche Kraftwerk). The second Gundremmingen unit was completed in 1984 and is scheduled to enter commercial operation in early 1985. Other units near commercial service include Preussenelektra's Grohnde unit, which Kraftwerk Union turned over to the wholesale utility in January 1985, and the THTR 300 (thorium high-temperature reactor) at Hamm-Uentrop. The THTR consortium, Hochtemperatur-Kernkraftwerk GmbH, hopes for approval from the state government for commercial operation in the coming weeks. (Instead of fuel rods, the THTR's core at full power contains 675,000 spheres, each consisting of one gram of high-enriched uranium and ten grams of thorium, surrounded by graphite.)

Table 16

NUCLEAR POWER UNITS IN THE FEDERAL REPUBLIC OF GERMANY

Fuel Buyer	Unit	MWe (net)	Type	COD	Percent Complete
Badenwerk, EVS[1]	Philippsburg 1	864	BWR	2/80	100
	Philippsburg 2*	1268	PWR	5/85	95
Bayernwerk	Grafenrheinfeld	1235	PWR	6/82	100
	Isar 1	870	BWR	3/79	100
	Isar 2*	1285	PWR	4/89	40
GKN[2]	GKN 1	795	PWR	12/76	100
	GKN 2*	1230	PWR	mid-1989	20
HEW[3]	Brunsbuettel	771	BWR	2/77	100
	Kruemmel	1260	BWR	3/84	100
KWO[4]	Obrigheim 1	328	PWR	3/69	100
NWK[5]	Stade	630	PWR	5/72	100
	Unterweser	1230	PWR	10/79	100
	Brokdorf*	1290	PWR	1987	65
Preussenelektra	Wuergassen	640	BWR	3/72	100
	Grohnde*	1290	PWR	6/85	100
RWE[6]	Biblis A	1146	PWR	3/75	100
	Biblis B	1240	PWR	1/77	100
	Gundremmingen B	1244	BWR	7/84	100
	Gundremmingen C*	1244	BWR	4/85	100
	Kaerlich*	1227	PWR	8/86	85
SBK[7]	Kalkar*	295	LMFBR	4/87	85
VEW[8]	THTR 300*	296	HTR	5/85	100
	Emsland*	1242	PWR	10/88	40
Total		22,910			

*Unit under construction.
[1]EVS = Energie-Versorgung Schwaben AG.
[2]GKN = Gemeinschaftkernkraftwerk Neckar.
[3]HEW = Hamburgische Elektrizitaetswerke AG.
[4]KWO = Kernkraftwerk Obrigheim GmbH.
[5]NWK = Nordwestdeutsche Kraftwerk AG.
[6]RWE = Rheinisch Westfaelisches Elektrizitaetswerk AG.
[7]SBK = Schnell-Brueter Kernkraftwerksgesellschaft.
[8]VEW = Vereinigte Elektrizitaetswerke Westfalen AG.

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Figure 3

NUCLEAR POWER STATIONS IN THE FEDERAL REPUBLIC OF GERMANY

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Under the ruling Christian Democrats, the nuclear power plant construction program in the FRG has progressed relatively smoothly in recent years. KWU has been able to achieve exceptional construction performance in several cases, most notably the standard 1,300-MWe convoy units. The Emsland unit in Lower Saxony is scheduled to be completed in under five years. Work on Isar Unit 2, brought to a costly three-month halt in 1984, is now approaching the original construction schedule. A district court in Bavaria had ordered the construction halt in January 1984 following a private suit, but the state court overruled the order shortly thereafter, limiting the work stoppage to ten weeks.

The political opposition to the utilities' power projects primarily is concentrated at the state and local levels. (There are eight states and three city-states in the FRG. Six of the states have nuclear plants.) Most utilities having units planned or under construction are highly sensitive to the results of state government elections, since the state governments may have the power to deny construction and operating licenses. Such a denial has occurred in the state of Hesse, a Green Party stronghold, where Preussenelektra has wanted for several years to build the Borken unit at the site of an important transforming junction for the national grid. The recent decision to build a reprocessing plant in Bavaria was made largely because of the relatively favorable political climate in that state.

The FRG's utilities continued to take fuel deliveries from a wide range of suppliers during 1984. The principal sources of natural uranium were Southern Africa and Australia; three West German companies own shares in Energy Resources of Australia (ERA) and several of the utilities have long-term contracts with NUFCOR in South Africa or Rossing in Namibia. Urenco, which recently completed construction on its third separative work plant at Gronau in northwest Germany (Figure 4), became the leading long-term enrichment supplier for German utilities during 1984. The German consortium Uranit (owned by Hoescht, Nukem and Preussenelektra) is a one-third partner in Urenco (Figure 5). Utilities converted only three units to the USEC (one of them being the THTR, which requires 93-percent enriched uranium for a portion of its fuel). The USSR still supplies a relatively small portion of enrichment requirements, and one utility has signed a contract with Cogema.

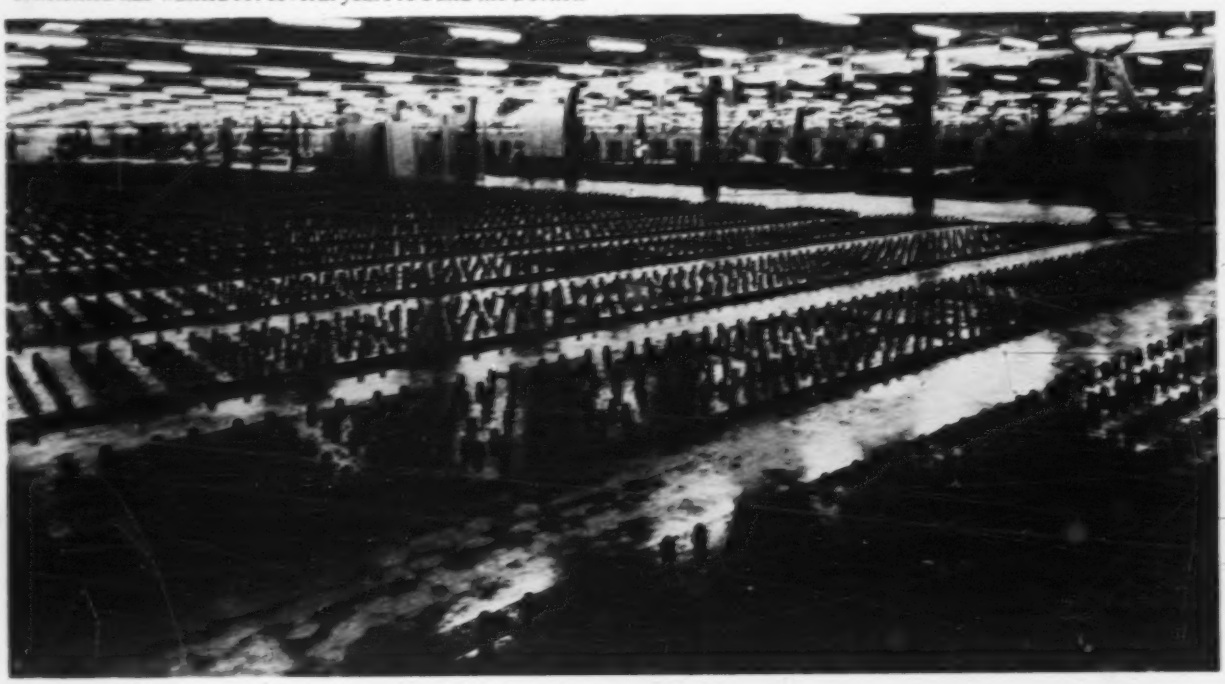

Figure 4. Urenco enrichment facility, prior to installation of centrifuges.

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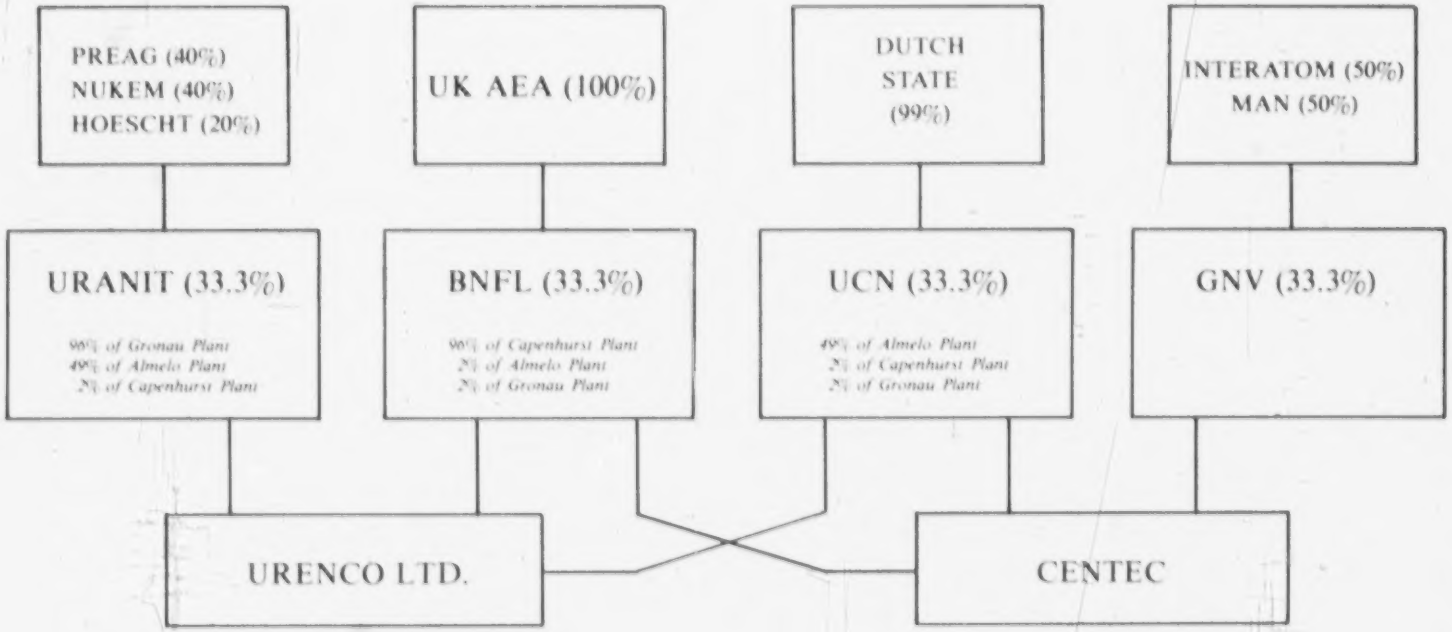

BNFL	British Nuclear Fuels Ltd. PLC	PREAG	Preussenelektra AG
CENTEC	Gesellschaft fuer Centrifugentechnik mbH	UCN	Ultra-Centrifuge Nederland NV
GNV	Gesellschaft fuer Nukleare Verfahrenstechnik mbH	UKAEA	United Kingdom Atomic Energy Authority
MAN	Maschinenfabrik Augsburg-Nuerenberg AG	URANIT	Uran-Isotopentrennungsgesellschaft mbH

Figure 5

OWNERSHIP STRUCTURE OF URENCO GROUP

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ITALY

The National Energy Plan (NEP) announced in 1981, with its ambitious plans for nuclear-generated power, has made slow progress through 1984. Over 60 percent of the nation's electricity is still generated by oil, and the NEP target of 51-percent dependence by 1990 will not be realized. A growing number of regions are becoming interested in hosting a nuclear plant, due to generous financial incentives from ENEL (Ente Nationale per l'Energia Elettrica), the state-owned utility. However, the country's nuclear plant construction program is beset with a multitude of problems and delays. Three commercially operating units generate 1,260 MWe, far below the NEP aim of 12,000-MWe capacity by 1990. Two 1,000-MWe units are under construction at Montalto di Castro, and the utility expects the units to reach commercial operation in 1988. In July 1984, the first of two reactor pressure vessels for the plant was shipped from Milan to the construction site in central Italy. Plans for six other 1,000-MW units divided between Puglia, Lombardy and Piedmont remained indefinite during much of 1984. Protracted site selection measures for the Piedmont plant took place over the course of the year, and in June ENEL submitted a study proposing two alternate sites for the two-unit plant. The regional council of Piedmont announced its decision in January 1985. The 2,000-MWe PWR plant will be built near Trino Vercellese, approximately 10 kilometers from the 270-MWe Trino unit, in operation since 1965. ENEL will act as architect-engineer during construction and as owner-operator when the plant is in service. Site preparation could begin as early as April 1985.

While the plant is under construction, the region around Trino will receive from ENEL approximately 24 billion lire (about $12 million), and will receive another six billion lire per year when the plant is in operation. The plant will be the first standardized Italian PWR based on the Westinghouse model. The cost of the nine-year project has been estimated at 3,500 billion lire ($1.8 billion).

Both ENEL and Agip SpA, the Italian state energy conglomerate, own 8.1-percent shares in Eurodif. Because the demand for enriched uranium in Italy has been limited, both companies have resold on the international market portions of their shares of Eurodif enrichment. In addition, ENEL has negotiated electricity-for-SWU agreements with Eurodif that enable it to import electricity from EDF in lieu of Eurodif enrichment services.

NETHERLANDS

Two reactors, with a total capacity of about 500 MWe, are in commercial operation in the Netherlands. The Dutch utility PZEM (Provinciale Zeeuwse Energie Maatschappij) operates the 445-MWe Borssele PWR plant. PZEM converted its abbreviated 5-year Requirements contract to the USEC for the Borssele reactor, but Urenco will assume SWU deliveries later in the decade. The Dutch company Ultra-Centrifuge Nederland (UCN) owns 33.3 percent of Urenco. In addition, one of the two Urenco enrichment facilities is located at Almelo, the Netherlands.

A heated debate over plans for the construction of more nuclear power plants captured public and governmental attention in 1984. In late 1983, a national opinion poll had indicated that over half of those interviewed openly opposed nuclear power. However, the poll was rather inconclusive in that it drew only a small fraction of Dutch voters. Nevertheless, many environmental and peace groups used this survey as justification for their efforts to discourage the ministries of economics and environment from supporting development plans as an extensive parliamentary review drew near. The ruling coalition parties (Conservative and Christian Democrat) support construction of new units, but the more populous Labor party has claimed it will attempt to block any new plants. After several postponements in December, the Dutch cabinet in January 1985 recommended the construction of 1,800 to 4,000 MW of additional nuclear generating capacity to meet anticipated electricity demand in the mid-1990s. However, it will be left to Dutch utilities to submit detailed plans, with the concurrence of local governments, subject to parliamentary approval.

The government's recommendation included provisions for the construction of at least two 900 to 1,300-MW nuclear units to provide low-cost electricity to Dutch industry in the next decade. Of six sites identified, the Borssele location was preferred. The government hopes it is possible to begin construction by early 1988 and to begin operation in 1995.

PORTUGAL

Domestic uranium production operations controlled by the Empresa Nacional de Uranio (ENU) yielded approximately 280,000 pounds U_3O_8 in 1984, a 20-percent increase over the previous year. ENU mines ore from six deposits, and the ore is milled at Urgeirica. Production could increase substantially if deposits in the Nisa district are exploited.

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SPAIN

Political Developments

After months of heated debate between utilities and the government, the Socialist Cabinet in April 1984 approved a new energy plan for the country which reduced projected nuclear capacity from 12,500 MW to 7,500 MW by 1992. The plan effectively cancels four nuclear units that were under construction and three that were planned (Table 17). Angry reactions from utilities and nuclear organizations followed the plan's announcement.

Under the plan, coal use will be promoted with the construction of eight new coal-fired plants. The government also hopes to reinforce the role of natural gas in its energy program. The nuclear energy share will rise from 2.8 percent in 1982 to 10.4 percent in 1992 with the addition of four units scheduled for operation between 1984 and 1988, but four other units already under construction have been indefinitely deferred. Those include the two Lemoniz units in the Basque region and the two Valdecaballeros units in Extremadura. In addition, three planned units have been shelved. The plan included an "automatic revision clause" which could have been implemented if energy consumption rose more than the 3.3 percent predicted by the government's plan. While consumption did in fact rise approximately five percent over the first nine months of the year, Secretary of State for Energy Martin Gallego said that the government had no intention of revising the plan unless the consumption rise turned out to be much higher.

Table 17

SPAIN'S REVISED NUCLEAR POWER PROGRAM

Unit	Utility	MWe	Type	COD
Operating				
Jose Cabrera[1]	UE[2]	160	PWR	Aug 1969
Garona	Nuclenor[3]	460	BWR	Mar 1971
Vandellos 1	Hifrensa[4]	500	GCR	Jul 1972
Almaraz 1	HE[5]/CSE[6]/UE/Iberduero	930	PWR	Aug 1981
Almaraz 2	HE/CSE/UE	930	PWR	Dec 1983
Asco 1	Fecsa[7]/Enher[8]	930	PWR	Jun 1984
Cofrentes	HE	975	BWR	May 1985
Asco 2	Fecsa/Enher	930	PWR	Jun 1985
Under Construction				
Trillo 1	UE/Iberduero	1032	PWR	Aug 1987
Vandellos 2	Enher/HC[9]	982	PWR	1987
Total		7,829		
Indefinitely Deferred				**Percent Complete**
Lemoniz 1	Iberduero	900	PWR	97
Lemoniz 2	Iberduero	900	PWR	57
Valdecaballeros 1	HE/CSE	975	BWR	52
Valdecaballeros 2	HE/CSE	975	BWR	40
Trillo 2	UE/Iberduero	997	PWR	0
Regodola	Fedeno[10]	1000	PWR	0
Sayago	Iberduero	1075	PWR	0
Total		6,822		

[1]Also known as Zorita.
[2]UE = Union Electrica.
[3]Nuclenor = Centrales Nucleares del Norte SA.
[4]Hifrensa = Hispano-Francesa de Energia Nuclear SA.
[5]HE = Hidroelectrica Española SA.
[6]CSE = Compania Sevillana de Electricidad SA.
[7]Fecsa = Fuerzas Electricas de Cataluna SA.
[8]Enher = Empresa Nacional Hidroelectrica Ribagorzana SA.
[9]HC = Hidroelectrica de Cataluna SA.
[10]Fedeno = Fuerzas Electricas del Noroeste SA.

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The Spanish Nuclear Society, which said the new plan would cause the loss of 70,000 jobs immediately, hoped the rise in consumption would trigger the revision clause so that the partially constructed plants could be completed. The government, however, must decide how to cope with the financial implications of its decision. In September, the Direction General de la Energia proposed an increase in electricity rates, including a 3.9-percent raise to fund the nuclear power cutback. The money would be distributed to the suspended projects. In addition, the Ministry for Economy suggested the levy of a special tax on electricity rates and utilities to pay for a ten-fold expansion of CSN (Consejo de Seguridad Nuclear), the nuclear safety agency.

Operating Units

The Cofrentes unit, a General Electric BWR, was connected to the grid in October 1984, bringing Spain's operating nuclear capacity to almost 5,000 MWe. The unit should enter commercial operation in early 1985. Six other units are in commercial operation. Three units are nearing completion; Asco Unit 2, a 930-MWe PWR, underwent testing in 1984 and is expected to begin operating in mid-1985. Trillo Unit 1 and Vandellos Unit 2 are scheduled to begin commercial operation in 1987 and 1988, respectively. Provided the government plan is realized, ten units having a cumulative generating capacity of 7,829 MWe will be in operation in 1992.

ENUSA, the state-owned fuel cycle services company, converted to the USEC all nine of its AFCs. A Eurodif shareholder, it had given notice to DOE for termination of its AFCs after 1992, but in negotiations in September, the two parties reached an agreement. The agreement allows ENUSA to employ its substantial inventory of DOE-enriched UF_6 prior to taking 70 percent of future requirements for nine units from DOE. Eurodif will provide enrichment for Vandellos Unit 2 and Trillo Unit 1, and may supply some portion of ENUSA's other requirements at a later date. ENUSA also has a small contract with the USSR.

Industry Ownership

At the end of 1984, after several months of bargaining, Spanish utilities agreed to a 600-billion-peseta ($3.3 billion) asset-swap maneuver, which altered the ownership structure of several nuclear units. The swap was designed to correct disparities in the market quota structure that were created by the new energy plan. Share participation in several plants, including Almaraz Unit 1, Vandellos Unit 2 and Trillo Unit 2, was redistributed among utilities. Both the government and the utilities agreed that the reorganization was necessary so that a utility's electricity production would approximate its market share.

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EUROPE

SWEDEN

Sweden's ten commercially operating reactors with 7,355-MWe generating capacity make its nuclear program the fourth largest in Europe, behind France, the United Kingdom and the Federal Republic of Germany. Nuclear power generated 41 percent of Sweden's electricity in 1984, up from 37 percent in 1983. Hydroelectric power provides almost all of the remaining electricity. Like many industrialized nations, Sweden's principal motivation for developing nuclear energy has been to reduce the percentage of energy requirements supplied by imported oil. Electricity use has grown steadily in recent years, and as nuclear and hydropower sources have been utilized, oil consumption has fallen. Oil imports now supply only 55 percent of the nation's total energy. The Swedish parliament in 1984 reaffirmed a bill calling for the continued reduction of oil use to 40 percent of total energy consumption.

Sweden's 12 units are located at four installations (Table 18). The Swedish State Power Board (SSPB), the nation's largest electrical utility, operates the four-unit Ringhals plant on the west coast. The plant is the largest nuclear power facility in the country. Ringhals Units 2, 3 and 4 are Westinghouse PWRs, the only commercial reactors in the country not supplied by Asea-Atom (the reactor vendor owned by the industrial conglomerate Asea and the Swedish government). In January 1984, all four Ringhals units, totaling 3,350 MWe, operated at 100-percent power for the first time. SSPB also is the majority owner of the Forsmark plant north of Stockholm. The utility received a fuel-loading license for Forsmark Unit 3, a 1,060-MWe BWR, in October 1984, and it expects the unit to begin commercial operation in mid-1985.

Sydkraft is the second largest utility. Its subsidiary Sydsvenska Varmekraft AB operates the two-unit Barseback plant. OKG (Oskarshamnsverkets Kraftgrupp AB), a consortium of private companies led by Sydkraft (38 percent), owns and operates the Oskarshamn plant, the site of the first commercial unit built in Sweden. All three Oskarshamn units are Asea-Atom BWRs, and the 1,050-MWe Unit 3 is scheduled to begin commercial operation in August 1985. Oskarshamn Unit 1 was the best performing reactor in Europe for the first half of 1984, achieving a

Table 18

COMMERCIAL NUCLEAR PLANTS IN SWEDEN

Unit	Utility	MWe	Type	COD[1]
Oskarshamn 1	OKG[2]	440	BWR	Feb 1972
Oskarshamn 2	OKG	595	BWR	Dec 1974
Oskarshamn 3	OKG	1050	BWR	Aug 1985
Barseback 1	Sydkraft[3]	570	BWR	Jul 1975
Barseback 2	Sydkraft	570	BWR	Jul 1977
Ringhals 1	SSPB[4]	750	BWR	Feb 1976
Ringhals 2	SSPB	800	PWR	May 1975
Ringhals 3	SSPB	915	PWR	Apr 1981
Ringhals 4	SSPB	915	PWR	Nov 1983
Forsmark 1	FKA[5]	900	BWR	Dec 1980
Forsmark 2	FKA	900	BWR	Jul 1981
Forsmark 3	FKA	1060	BWR	May 1985
Total		9,465		

[1]Actual or expected Commercial Operation Date.
[2]Sydkraft AB owns 38 percent of OKG.
[3]Sydvenska Varmekraft AB, a subsidiary of Sydkraft AB, is the owner and operator of the Barseback plant.
[4]SSPB = Swedish State Power Board.
[5]FKA = Forsmarks Kraftsgrupp AB. SSPB owns 74.5 percent of FKA and is the operator and fuel purchaser for the plant.

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93.6-percent capacity factor. When Oskarshamn Unit 3 and Forsmark Unit 3 achieve full operation and complete Sweden's current nuclear program, the nuclear portion of Sweden's electricity supply will rise to almost 50 percent.

Nuclear waste disposal and safety issues were prominent in 1984. Legislation in February replaced several laws governing waste handling and reprocessing. The 1984 Act on Nuclear Technical Activities superseded a 1977 law which prohibited fuel loading until the reactor operator has demonstrated to the government authority that high-level waste will be handled and disposed of safely. The 1977 law also required utilities to obtain reprocessing contracts before nuclear units could be licensed. The 1984 Act replaced it and several other laws, including the 1956 Atomic Energy Act, and removed the requirement to have reprocessing contracts in place. (There is still a requirement to show the capability for eventual reprocessing.) It also dictated that each reactor owner must carry out a comprehensive research and development program to ensure safe disposal of waste. In addition, the four nuclear power utilities, under the auspices of the joint company SKB (Svensk Karnbranslehantering AB), have organized several waste management projects. SFR is a subterranean facility for the permanent storage of all low and medium-level wastes. Sitework began in early 1984, and excavation began at the end of the year. The offshore facility is located near the Forsmark power plant. CLAB (Central Temporary Storage Facility for Spent Fuel) is a facility for spent fuel located in a rock cavern near the Oskarshamn plant. SKB commissioned OKG for both construction and operation of CLAB. The facility is complete and ready to receive shipments of spent fuel in early 1985. A special ship designed for the transport of spent nuclear fuel, called Sigyn, has been in operation since 1982, taking shipments for reprocessing to Cogema and BNFL. It will transport material to CLAB.

Each Swedish utility has arranged its own enrichment supply. Sydkraft converted its Requirements contracts (one 3.5-year and one 5-year) to the USEC, after having previously terminated much of its obligation to DOE in the early 1980s. SSPB did not sign the USEC, and continues to be covered by five AFC and two 3.5-year Requirements contracts for the Ringhals and Forsmark plants. OKG also did not sign the USEC, and Oskarshamn Units 1 and 2 continue to be supplied by 3.5-year Requirements contracts. The USSR will provide enrichment for Unit 3. SSPB and OKG will take long-term enrichment services from both Eurodif and Urenco later in the decade, under agreements reached in 1984.

SWITZERLAND

The 925-MWe BWR at Leibstadt, operated by Kernkraftwerk Leibstadt (KKL), achieved commercial operation in December 1984, bringing the total number of operating Swiss nuclear units to five (Table 19). The units now generate 37 percent of Switzerland's electricity. The Leibstadt plant underwent fuel loading and began testing in March 1984, and was connected to the grid in June. The Swiss government in April rejected appeals by intervenors to stay the operating license. The intervenors, from Switzerland and southern Germany, had filed a variety of complaints, using environmental and emergency planning arguments among others, which are still under review. Nevertheless, their complaints have not yet interfered with plant operations.

Table 19

NUCLEAR POWER UNITS IN SWITZERLAND

Unit	Utility	MWe	Type	COD[1]
Operating				
Beznau 1	NOK[2]	350	PWR	Dec 1969
Beznau 2	NOK	350	PWR	Mar 1972
Muehleberg	BKW[3]	320	BWR	Oct 1972
Goesgen	KKG[4]	920	PWR	Nov 1979
Leibstadt	KKL[5]	925	BWR	Dec 1984
Planned				
Kaiseraugst	KWK[6]	925	BWR	1993
Graben	KWG[7]	1,140	BWR	indefinite

[1] Actual or expected Commercial Operation Date.
[2] NOK = Nordostschweizerische Kraftwerk AG.
[3] BKW = Bernische Kraftwerk AG.
[4] KKG = Kernkraftwerk Goesgen Daeniken AG.
[5] KKL = Kernkraftwerk Leibstadt AG.
[6] KWK = Kernkraftwerk Kaiseraugst AG.
[7] KWG = Kernkraftwerk Graben AG.

A history of delays made the Leibstadt unit Switzerland's most expensive nuclear plant. Cost escalations stemmed from several problems, notably the need to install a cooling tower for the BWR after plans to use the Rhine River for cooling were blocked by the Swiss Federal Executive Council in 1971. The Council cited thermal pollution of the Rhine as the reason behind its decision. In 1973, KKL obtained permission to build the plant with a cooling tower. The plant's proximity to the border with

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EUROPE

the Federal Republic of Germany (FRG) necessitated a bilateral agreement between Switzerland and FRG for joint monitoring of the installation. The plant's ownership includes both Swiss and German interests.

The future of the last two planned reactors, Kaiseraugst and Graben, remained uncertain at the end of 1984 despite the September defeat of the anti-nuclear initiatives. The approved site for the Kaiseraugst plant, 13 kilometers from Basel, is the subject of a great deal of controversy. Basel and the surrounding regions are vigorously opposed to the plant, and voted overwhelmingly in favor of the anti-nuclear initiatives (the only region to do so). Nevertheless, the defeat of the proposals allowed the approval process for Kaiseraugst to proceed. The process had been postponed until the results of the initiatives were known. The lower house (Nationalrat) of the Swiss Parliament approved the need for the unit at the end of March 1985. Now the unit's utility, Kernkraftwerk Kaiseraugst (KWK) may start the procedure for obtaining a construction permit. Due to lengthy licensing procedures, construction probably will not begin for the next two to three years. Plans for the 1,140-MWe Graben BWR made little progress in 1984. Status of the plant remains indefinite, although the approval process might start when Kaiseraugst begins licensing and construction.

In a popular vote held September 23, 1984, the Swiss public repudiated two initiatives designed to curtail the future use of nuclear power. The rejection was a major victory for the utilities, which had mounted a formidable campaign against the initiatives, stressing the positive aspects of nuclear power. Amendments to the Swiss constitution require a double majority; that is, both a majority of the popular votes and a majority of cantons must approve the initiatives. This is significant because in the election, the popular vote was 55 percent to 45 percent against the initiatives, and 17 cantons voted against the initiatives, a true landslide. One of the initiatives, which would have imposed a moratorium of indefinite length on the construction of any power plant having a capacity of more than 35 megawatts, was rejected by 54 percent of the voters. The other initiative, proposing a "future without atomic power plants," was rejected by 55 percent of the voters. Many of the more than 50 organizations that supported the initiatives have vowed to continue their opposition, and a new drive to put another anti-nuclear initiative on the ballot has begun. However, the process, requiring the signatures of 100,000 qualified voters, usually takes at least three years and will have difficulty gaining momentum in the wake of the public mandate in September.

The Swiss utilities followed separate paths for obtaining enrichment coverage for future requirements. BKW (Bernische Kraftwerk) converted a 3.5-year Requirements contract for its operating unit (Muehleberg) to the USEC, as well as the AFC that covered the proposed Graben unit (BKW owns 45 percent of the unit). The conversion will cover 70 percent of requirements. NOK (Nordostschweizerische Kraftwerk) also converted to the USEC for one of its Beznau units, and has a contract with Urenco for the other. KKL converted its AFC to the USEC for one delivery in 1985 until a long-term contract with Cogema commences later in the year. Similarly, KKG (Kernkraftwerk Goesgen) agreed to a long-term contract with Cogema to succeed its AFC. Kaiseraugst is also covered by Eurodif.

UNITED KINGDOM

Four Advanced Gas-cooled Reactors (AGR) operated by the Central Electricity Generating Board (CEGB) entered commercial service in 1984. In addition, two units should achieve commercial operation in 1985, and four more are scheduled for operation by 1988 (Table 20). Nuclear power accounts for approximately 15 percent of the electricity generated in the UK as a whole, but in Scotland, that figure is approaching 30 percent. With the completion of the remaining AGRs by the end of the decade, nuclear power will account for 25 percent of the UK's electricity production.

The considerable progress in the implementation of the long-delayed commercial AGR program undoubtedly influenced the ongoing Sizewell inquiry. The inquiry, which began in January 1983, continued to examine the feasibility, impact and economics of the proposed Sizewell B unit, the nation's first PWR. The analysis had evolved into a general debate of the future of nuclear power in the UK, but the recent success of the AGR focused the study in later months on the wisdom of abandoning the AGR, which was developed in the UK. Final evidence was presented for the inquiry at the end of February 1985, but the Inspector's formal report regarding the PWR program is not expected until Autumn 1985. Due to the length of the inquiry, the utility delayed by 21 months the expected date for the start of construction.

A coal miners' national strike over most of 1984 threatened CEGB's primary fuel source and placed greater

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dependence on the nation's nuclear plants. The strike officially ended in March 1985, so CEGB's primary fuel supply is stable.

The British Civil Uranium Procurement Directorate (BCUPD) is responsible for supplying the natural uranium needs of the country's plants. Its five board members include one from BNFL, one from SSEB, and three from CEGB. BCUPD's mandates are administered by the British Civil Uranium Procurement Organization (BCUPO).

BCUPO took its last U_3O_8 deliveries from Namibia's Rossing mine in 1984, and has not renewed its supply contract with the producer. BCUPO still purchases material from Canadian sources. Urenco Ltd., of which BNFL owns 33.3 percent, supplies most of the enrichment needs for UK's nuclear plants. BNFL owns 96 percent of Urenco's Capenhurst plant, located in northwest England. The USSR also supplies a small portion of the UK's enrichment requirements.

Table 20

COMMERCIAL NUCLEAR UNITS IN THE UNITED KINGDOM

Station/Units	MWe net per Reactor	Type	Operating Entity	COD	Percent Complete
Calder Hall 1,2,3,4	50	GCR	BNFL[1]	1956	100
Chapel Cross 1,2,3,4	50	GCR	BNFL	1958	100
Berkeley 1,2	138	GCR	CEGB[2]	1962	100
Bradwell, 1,2	150	GCR	CEGB	1962	100
Hunterston A1,2	160	GCR	SSEB[3]	1964	100
Trawsfynydd 1,2	250	GCR	CEGB	1965	100
Hinkley Point 1,2	250	GCR	CEGB	1965	100
Dungeness A1,2	275	GCR	CEGB	1965	100
Sizewell A1,2	290	GCR	CEGB	1966	100
Oldbury 1,2	300	GCR	CEGB	1968	100
Wylfa 1,2	590	GCR	CEGB	1971	100
Hinkley Point B1	625	AGR	CEGB	1976	100
Hinkley Point B2	625	AGR	CEGB	1977	100
Hunterston B1	625	AGR	SSEB	1976	100
Hunterston B2	625	AGR	SSEB	1977	100
Dungeness B1	600	AGR	CEGB	1984	100
Heysham A1	625	AGR	CEGB	1984	100
Heysham A2	625	AGR	CEGB	1984	100
Hartlepool A1	625	AGR	CEGB	1984	100
Hartlepool A2	625	AGR	CEGB	1985	100
Dungeness B2	600	AGR	CEGB	1985	100
Heysham B1	660	AGR	CEGB	1987	70
Heysham B2	660	AGR	CEGB	1988	55
Torness Point 1	660	AGR	SSEB	1987	50
Torness Point 2	660	AGR	SSEB	1988	34
Sizewell B1	1110	PWR	CEGB	indefinite	0

[1]BNFL = British Nuclear Fuels Ltd.
[2]CEGB = Central Electricity Generating Board.
[3]SSEB = South of Scotland Electricity Board.

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YUGOSLAVIA

One commercial nuclear power plant currently is in operation in Yugoslavia. The Krsko unit, a 615-MWe Westinghouse PWR, is owned by the government utilities Savske Elektrane in Slovenia (50 percent) and Elektroprivreda in Croatia (50 percent). The unit began commercial operation in December 1981. Extensive plans for the construction of more nuclear generating facilities were announced in 1984. According to official reports, utilities are preparing to begin construction on at least five units by the end of the century, although that estimate is somewhat optimistic. Most utilities are in the earliest stages of planning, following the procedure of organizing a subsidiary to handle financing and construction of the plants. The Prevlaka plant is likely to be the next unit under construction. The utility Elektrovojvodina continued negotiations for joint-venture partners for the 1,000-MWe plant, which probably would be located in Croatia. Meanwhile, the utility explored the possibilities of beginning construction in 1988 on a plant along the Danube River in the province of Vojvodina. In addition, the Republic of Bosnia-Herzegovina in November reported plans to begin construction on a 410-MWe plant scheduled for operation in 1996. A 935-MWe plant would follow, with an operational target of 2003. At present, however, construction of only the Prevlaka plant appears likely before the end of the century.

Nuklin, the Association of Nuclear Research Institutes of Yugoslavia, in June submitted a proposal for extensive research and development in the nuclear fuel cycle. The report outlined a program covering fourteen basic projects encompassing the full range of fuel cycle services, from uranium exploration techniques to spent fuel handling. The federal government's Nuclear Energy Commission requested the study, which was aimed at promoting the attainment of a high degree of fuel cycle self-sufficiency over the next several decades. Government approval of some form of the proposal is not expected for some time.

Uranium production in Yugoslavia began in late 1984 with trial operations at a mine located at Goreije Vas in Slovenia. Construction of a mill at the Zirovski Vrh mine site was completed in August 1984. The mill, designed by Fluor Mining and Metal Company, underwent plant inspections in July and August, and was targeted to produce 30 metric tons uran... n by the end of 1984. Full production levels should be achieved by 1986. It has a throughput capacity of 210,000 metric tons of ore per year. The Zirovski Vrh mill is expected to supply U_3O_8 destined for refueling of the Krsko power plant. For its enrichment needs, Krsko signed the USEC for its only unit.

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JAPAN

Introduction

The progress of Japan's nuclear industry in 1984 was highlighted by several significant accomplishments and other events.

1. Three nuclear power plants began commercial operation, increasing Japan's utilities' total nuclear generating capacity by 2,514 MWe, to a total of 19,691 MWe. Four additional facilities, comprising a total of 3,940 MWe, reached criticality and will begin commercial operation in 1985.

2. Siting problems for future commercial enrichment and reprocessing facilities were resolved. In a unique approach to the siting problem, the utilities have proposed building the plants at a common location, along with another facility for centralized long-term storage of low-level radioactive wastes from nuclear plants.

3. The utilities concluded negotiations with the US DOE to reorganize their supplies of enrichment services by means of the Utility Services enrichment contract (USEC).

Operating Nuclear Plants

Table 21 summarizes the current status of operating nuclear generating facilities for Japan's utilities. Twenty-eight plants with a total capacity of 20,561 MWe constitute approximately 15 percent of Japan's total electrical generating capacity. Nuclear power accounted for more than 20 percent of total electricity generated in 1984.

Three plants which achieved criticality in 1983 attained commercial operation in 1984. Fukushima II Unit 2 (a 1,100-MWe BWR); Onagawa Unit 1 (a 524-MWe BWR); and Sendai Unit 1 (an 890-MWe PWR). In addition, three plants loaded fuel in 1984 and, after testing, will enter commercial operation in 1985; Takahama Un. 4 (an 870-MWe PWR); Fukushima II Unit 3; and Kashiwazaki Unit 1 (both 1,100-MWe BWRs). Takahama Unit 3, an 870-MWe PWR, began commercial operation in January 1985. The Fukushima plant is the sixth of ten BWRs Tokyo Electric Power Co. will operate at that site. Kashiwazaki Unit 1 is the first of five BWRs (and possibly more) to be located at a common site. In 1984, the 27 operating plants had an average capacity of 72.3 percent, the third year in a row in which Japan's nuclear plants have achieved an average capacity factor greater than 70 percent.

Until 1984, nuclear generating costs in Japan showed an apparent advantage over fossil fuel and hydroelectric generation facilities. In 1984, however, increases in nuclear plant construction costs, combined with relatively stable fossil fuel prices, narrowed the cost differentials. Table 22 compares plant and generating costs for various types of electrical generating facilities. Nuclear generation costs do not include future plant decommissioning or long-term waste disposal costs. Inclusion of such factors would result in almost identical costs for nuclear power and coal power.

The Japanese Ministry of International Trade and Industry (MITI) estimated the cost information presented in Table 22 based on generation facilities which began in 1984, using designs and sizes which are believed to reflect the current state of technology, and estimating 70 percent plant availability. In a late 1984 report, MITI reaffirmed government policy to continue emphasizing nuclear generation. MITI expected eventual increases in fossil fuel prices, and cited the need for delivery of fuel supply. Further, it noted that one reliable way of stockpiling fuel consisted of loading fuel into a nuclear reactor.

Plant Construction and Licensing

Four nuclear power plants obtained establishment permits (combined construction and operating licenses) in 1984. (See Report 168 for a discussion of Japan's nuclear plant licensing procedure.) Hokkaido Electric Co. received the permits for its Kyowa-Tomari Units 1 and 2 (both 579-MWe PWRs) and started construction. Kyushu Electric Co. received permits for its Genkai Units 3 and 4 (1,180-MWe PWRs) and will start construction in August 1985 following receipt of pending local construction permits.

In addition, Tokyo Electric Power announced its intention to proceed with two additional 1,100-MWe BWRs, Kashiwazaki Units 3 and 4, with expected operation dates of 1993 and 1994, respectively. Kansai Electric disclosed plans to expand its current Ohi site with the addition of two 1,180-MWe PWRs, Ohi Units 3 and 4. Commercial operation has been scheduled tentatively for 1991 and 1992, respectively. Initial public hearings for these four plants have been held, and as of February 1985, Ohi Units 3 and 4 achieved actual project status and are undergoing licensing. Table 23 summarizes the status of officially recognized nuclear plant projects in Japan.

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FAR EAST

Table 21

COMMERCIALLY OPERATING NUCLEAR POWER PLANTS IN JAPAN

Unit	Utility	Capacity (MWe net)	Type	Commercial Operation
Tokai 1	JAPC[1]	166	GCR	Jul 1966
Tsuruga 1	JAPC	357	BWR	Mar 1970
Mihama 1	Kansai EPC[2]	340	PWR	Nov 1970
Fukushima I-1	Tokyo EPC	460	BWR	Mar 1971
Mihama 2	Kansai EPC	500	PWR	Jul 1972
Shimane 1	Chugoku EPC	460	BWR	Mar 1974
Fukushima I-2	Tokyo EPC	784	BWR	Jul 1974
Takahama 1	Kansai EPC	826	PWR	Nov 1974
Genkai 1	Kyushu EPC	559	PWR	Oct 1975
Takahama 2	Kansai EPC	826	PWR	Nov 1975
Fukushima I-3	Tokyo EPC	784	BWR	Mar 1976
Hamaoka 1	Chubu EPC	540	BWR	Mar 1976
Mihama 3	Kansai EPC	826	PWR	Dec 1976
Ikata 1	Shikoku EPC	566	PWR	Sep 1977
Fukushima I-5	Tokyo EPC	784	BWR	Apr 1978
Fukushima I-4	Tokyo EPC	784	BWR	Oct 1978
Tokai 2	JAPC	1100	BWR	Nov 1978
Hamaoka 2	Chubu EPC	840	BWR	Nov 1978
Ohi 1	Kansai EPC	1175	PWR	Mar 1979
Fukushima I-6	Tokyo EPC	1100	BWR	Oct 1979
Ohi 2	Kansai EPC	1175	PWR	Dec 1979
Genkai 2	Kyushu EPC	559	PWR	Mar 1981
Ikata 2	Shikoku EPC	566	PWR	Mar 1982
Fukushima II-1	Tokyo EPC	1100	BWR	Apr 1982
Fukushima II-2	Tokyo EPC	1100	BWR	Feb 1984
Onagawa 1	Tohoku EPC	524	BWR	Jun 1984
Sendai 1	Kyushu EPC	890	PWR	Jul 1984
Takahama 3	Kansai EPC	870	PWR	Jan 1985
TOTAL MWe		20,561		

[1]JAPC = Japan Atomic Power Company
[2]EPC = Electric Power Company

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Nuclear Generation Forecasts

MITI, which is responsible for the government's policy regarding the establishment of objectives (for planning purposes) for future electrical generation, with support from related private sector advisory bodies, reaffirmed in 1984 the revised nuclear generating capacity forecasts:

FY1990: 34,000 MWe Installed
FY1995: 48,000 MWe Installed
FY2000: 62,000 MWe Installed

Based on the status of plants under licensing or under construction as indicated in Table 23, along with their current estimated operating dates, Nuexco projects that approximately 33,000 MWe of capacity will be in commercial operation by 1990. Combining the units listed in Table 23 with currently operating plants (Table 21) totals 36,000 MWe of capacity (including firmly committed projects with operation dates through 1994). Thus, if the MITI target of 48,000 MWe installed capacity by 1995 is to be achieved, Japan's utilities will need to add 12,000 MWe of planned capacity to current plants now undergoing licensing procedures. Based on the status of future projects as well as possible delays to current projects and new site development, Nuexco estimates Japan's utilities will add about half that much, reaching approximately 41,000-42,000 MWe installed capacity by 1995. Some future significant downward revision also can be expected for the MITI target for the year 2000.

Uranium Inventories

Japan's utilities received deliveries of approximately 22 million pounds of uranium in 1984. About 80 percent of the total arrived under long-term contracts completed in the 1970s with overseas suppliers at a time when government nuclear generation targets and utilities' plant schedules were optimistic. As late as 1979, plans targeted 33,000 MWe operating by 1985 (approximately equal to the present target for 1990). With four plants scheduled for commercial operation in 1985, the actual total will be 23,600 MWe.

Because actual needs represented only 60 to 70 percent of 1984 uranium deliveries, the Japanese utilities added approximately 8 to 9 million pounds equivalent U_3O_8 to inventory. Nuexco estimates that the utilities collectively hold *excess* inventories of about 55-60 million pounds equivalent U_3O_8 in various forms. (The term *excess inventories* means that amount by which cumulative deliveries to date exceed initial core and reload fuel requirements for reactors currently operating or under testing.) Under existing supply contracts, future deliveries to Japanese utilities will average about 15 million pounds of U_3O_8 per year through the mid-1990s. The majority of Japanese utilities currently hold excess inventory ranging from five to ten years' forward supply, although several have much smaller stockpiles. Based on current inventories, additional future deliveries, and a possible lowering of generation targets for 1995 and beyond, Nuexco estimates that

Table 22

1984 ELECTRICAL GENERATING COSTS IN JAPAN[1]

Source	Net Generation Cost[2] yen/KWh	(¢/KWh)	Approximate Fuel Cost as % of Net Generation Cost	Current Plant Construction Cost yen/KW	($/KW)
Hydro	21	(8.8)	—	630,000	(2,625)
Oil	17	(7.1)	75	140,000	(583)
Coal	14	(5.8)	45	240,000	(1,000)
Liquid Natural Gas	17	(7.1)	65	190,000	(791)
Nuclear	13	(5.4)	25	310,000	(1,292)

[1]Costs converted from Japanese yen to US dollar at approximate rate of 240 yen/dollar.
[2]Does not include transmission and distribution costs.

Source: Ministry of International Trade and Industry.

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the Japanese utilities are amply supplied with uranium at least through the mid-1990s.

With few exceptions, it is likely that Japanese utilities will be relatively inactive in the uranium market for several years. (One new supply contract and the extension of another were announced in early 1985.) Because most commitments are established by long-term contracts, the major activity will be the annual negotiation of prices for the following year's deliveries. Most deliveries in 1984 were in the range of $34-38 per pound U_3O_8. In late 1984, preliminary negotiations for most 1985 deliveries tentatively were concluded at $33-34 per pound.

Enrichment

The negotiations of the DOE Utility Services enrichment contract (USEC) for supply of enrichment services was a major event for the Japanese utilities in 1984. The nine private utilities and the Japan Atomic Power Corporation, which held primarily Adjustable Fixed Contracts (AFCs) and a small number of Requirements-type Contracts with DOE, all converted to the USEC. Of the utilities, the majority converted to 100 percent of requirements from DOE. Four utilities (Chugoku, Hokkaido, Shikoku, and Tohoku Electric) elected to receive 70 percent of requirements. Because the Japanese utilities represent about 20 percent of DOE's total market, DOE viewed the Japanese response as a major accomplishment.

It appears the USEC contracts negotiated by each utility with DOE incorporated numerous special concessions for their Japanese customers, but details have yet to be disclosed. DOE's willingness to accommodate probably stemmed from a combination of factors specific to Japan.

Table 23

JAPANESE NUCLEAR POWER UNITS
UNDERGOING CONSTRUCTION AND UNDERGOING LICENSING

Unit	Utility	Capacity (MWe net)	Type	Estimated Commercial Operation
Under Construction				
Fukushima II-3	Tokyo EPC[1]	1100	BWR	Jul 1985
Takahama 4	Kansai EPC	870	PWR	Aug 1985
Kashiwazaki 1	Tokyo EPC	1100	BWR	Oct 1985
Sendai 2	Kyushu EPC	890	PWR	Mar 1986
Tsuruga 2	JAPC[2]	1160	PWR	Jun 1987
Hamaoka 3	Chubu EPC	1100	BWR	Sep 1987
Fukushima II-4	Tokyo EPC	1100	BWR	Sep 1987
Shimane 2	Chugoku EPC	820	BWR	Sep 1988
Kyowa Tomari 1	Hokkaido EPC	579	PWR	Jun 1989
Kashiwazaki 5	Tokyo EPC	1100	BWR	Apr 1990
Kashiwazaki 2	Tokyo EPC	1100	BWR	Oct 1990
Kyowa Tomari 2	Hokkaido EPC	579	PWR	Jun 1991
Genkai 3	Kyushu EPC	1180	PWR	Mar 1993
Genkai 4	Kyushu EPC	1180	PWR	Mar 1994
Undergoing Licensing[3]				
Ikata 3	Shikoku EPC	890	PWR	Oct 1990
Maki 1	Tohoku EPC	825	BWR	Mar 1994
TOTAL MWe		15,573		

[1]EPC = Electric Power Company
[2]JAPC = Japan Atomic Power Company
[3]Kansai EPC's Ohi Units 3 and 4 began licensing procedures in February 1985.

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1. Japan plans to build enrichment facilities for operation in the 1990s which ultimately would supply about 20 percent of total domestic utility needs.

2. Existing enrichment supply from Eurodif amounts to approximately one million SWUs annually to the private utilities under contracts extending through 1979, and those contracts could be extended.

3. About four million prepaid DOE SWUs remained undelivered. These SWUs represent the balance of the eight million SWUs paid for in advance by the Japanese utilities more than a decade ago at prevailing prices. At the time, the deliveries were prepaid in order to aid the Japanese government in efforts to reduce the trade imbalance between the USA and Japan.

4. The utilities currently hold large inventories of enriched uranium arising from SWU deliveries under previous AFC contracts, so the prospect of some relief from future deliveries was quite appealing to the Japanese.

Both Eurodif and Urenco marketed aggressively to the Japanese utilities in 1984. Utility involvement in USEC negotiations created an obstacle to those efforts. Moreover, DOE's indications that it probably would make offers of reduced-price SWU in the spring of 1985 compounded marketing difficulties for the non-US enrichers. As a result, utility managements chose to defer decisions until the realities of DOE's price reductions could be discerned. Urenco has not been successful in Japan to date. Eurodif has negotiated a significant extension of its supply contract to one Japanese utility, and is likely to obtain additional extensions with several other utilities.

From mid-1984 the Japanese utilities, via their coordinating organization, the Federation of Electric Power Companies (FEPC), took a major step in promoting Japan's move toward domestic commercial enrichment capability. The FEPC proposed the following, subject to local and national government approvals:

1. Construction of an enrichment facility capable of producing 150,000 SWU annually by 1991, with progressive expansion to 1.5 million SWU annual capacity by 1997. The latter capacity would equal approximately 20 percent of utilities' total needs in 1997. Current estimates place the facility cost at the equivalent of US $600 million.

2. The plant will use centrifuge technology developed by Power Reactor and Nuclear Fuel Company (PNC), a government-affiliated organization. PNC has developed and proven such technology as part of a government-sponsored national program which began in the early 1970s (see Report 189).

3. In a unique arrangement which resolves siting problems, the enrichment facility will be located adjacent to a commercial spent-fuel reprocessing facility and a central plant for storage of low-level radioactive wastes from the utilities' nuclear plants. The common site for the three facilities would be in the northern part of Japan's main island of Honshu, at a site designated as Rokkasho-mura.

4. The private utilities, with participation from about forty other companies associated with the nuclear industry, agreed to organize a new company (incorporated in March 1985) called Japan Nuclear Fuel Industries (JNFI). JNFI will build, own, and operate both the enrichment facility and central waste storage facility.

Following the FEPC proposal, organizers have begun the preparatory work, which appears to be on schedule. In addition, the three nuclear vendors which manufactured the centrifuge machines for PNC's enrichment development program (Hitachi, Toshiba, and Mitsubishi Heavy Industries) have organized a new company, Uranium Enrichment Machinery Co. (UEM), to fabricate centrifuges for JNFI's facility, as well as for PNC's continuing programs. For commercial demonstration of its technology, PNC is constructing an enrichment plant which is scheduled to produce 100,000 SWU per year by 1987, expanding to 200,000 SWU per year in 1988. UEM's initial annual production in 1986 will consist of the number of cascades needed to produce 100,000 SWU per year. Eventually UEM will fabricate enough centrifuges annually to produce 300,000 SWU per year.

Reprocessing

Since 1977, PNC has operated a 0.7-ton-per-day reprocessing plant based on European reprocessing technology. The plant was designed to demonstrate technology and serve as a basis for a commercial-scale domestic reprocessing facility. Although largely successful, the plant has been plagued by numerous mechanical problems, and as of the end of 1984 had processed less than 200 tons of spent nuclear fuel from domestic nuclear plants. In the interim, several utilities have processed nominal quantities of spent fuel via service contracts with European suppliers. However, most spent fuel discharged from reactors has been stored by the Japanese utilities in storage pools at the plant sites.

Establishing a commercial-scale domestic reprocessing capability has been a topic of discussion for the past decade, and in 1980, Japanese utilities organized Japan Nuclear Fuel Services (JNFS) for just such a purpose. Various plant proposals evolved, but JNFS encountered problems in finding an acceptable location. The recent FEPC announcement to locate the plant adjacent to planned enrichment and waste storage facilities elimi-

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nated the last apparent major obstacle to commercial domestic reprocessing.

As part of the above joint siting, FEPC indicated JNFS would proceed with an initial spent-fuel storage facility capable of storing 3,000 tons of spent fuel by 1991. The facility would provide relief for the storage facilities at individual nuclear plant sites which have been accumulating increasing amounts of fuel. A reprocessing facility with an annual capacity of 800 tons of spent fuel will be completed by 1995, and provisions will allow for future expansion. Initial plant cost is estimated to be the equivalent of US $3.0 billion.

Other Reactor Types

For more than 15 years, the Japanese government and private industry have undertaken joint development of other reactor types as alternatives to the current commercial LWR program. PNC successfully demonstrated fast breeder reactor (FBR) technology by operating a 75-MW (thermal) FBR in the late 1970s. A 280-MWe demonstration FBR scheduled for completion by PNC in 1985 was to follow the project. However, because of licensing, funding and organizational delays, completion now is scheduled for the early 1990s. Plans made in 1984 called for a joint conceptual study by PNC and the utilities to decide by 1987 on the status of a commercial-scale (1,000-MWe) demonstration FBR. Construction would begin following completion of the 280-MWe FBR. Long-range plans call for an actual commercial FBR to be operational by the year 2010, with a cost objective that the plant should not exceed 1.5 times the cost of an LWR of the same capacity.

PNC also has successfully operated since 1979 an advanced thermal reactor (ATR) with 165-MWe capacity. The ATR is a heavy-water-moderated, light-water-cooled reactor fueled with slightly enriched uranium. In 1984, it was decided that PNC would transfer its ATR expertise to the Electric Power Development Company (EPDC), another government-affiliated company which has undertaken a large portion of Japan's hydroelectric projects to date. EPDC will design and construct a 600-MWe commercial demonstration ATR with license application scheduled for 1986, and construction completion scheduled for the early 1990s. The plant's location will be in northern Honshu, not far from the private utilities' planned enrichment, reprocessing, and waste storage facilities.

Both the FBR and ATR are part of a national development program established in 1967. Program objectives included the reduction of utilities' needs for natural uranium (for which Japan is dependent on overseas suppliers) by recycling plutonium and depleted uranium. Participants viewed the ATR as an intermediate step leading to the full-scale replacement of LWRs with FBRs as Japan's basic commercial reactor. Initial planning for such a program would have permitted recycling in the 1990s. Current status indicates that the program, if viable, will probably not materialize until well into the next century. Current plans also call for the use of mixed oxide fuels in LWRs, and some test programs have been implemented. It appears, however, that LWRs using enriched uranium fuel will continue to be the basis for nuclear generation in Japan for the next several decades.

PEOPLE'S REPUBLIC OF CHINA (PRC)

The People's Republic of China announced the undertaking of an ambitious nuclear program in 1984. The outline of the program includes development of nuclear power in eastern and southern provinces with an eventual generating capacity of 2,000 MWe by 1990 and 10,000 MWe by 2000. Based on the history of development of nuclear power programs in other countries, such a plan, which involves the operation of 10 to 12 pressurized water reactors (PWRs) by year 2000, is quite optimistic.

The PRC signed several technical and commercial agreements with various countries in 1984. These included the following:

1. A joint agreement with the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan for uranium exploration;
2. An agreement with Bechtel of the USA for the formation of a joint company (China American International Engineering);
3. An agreement with Klein, Schauzlin and Becker AG from the Federal Republic of Germany for main coolant pumps;
4. An agreement with the Comax Buffalo Corporation from the USA for containment penetration;
5. An agreement with Mitsubishi Heavy Industries from Japan for a PWR pressure vessel. The French company Framatome may be awarded a sizable part of the work on the first PWRs to be built in the Quandong Province as part of the Daya Bay Project.

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THE PHILIPPINES

The only nuclear power plant in the Philippines, Bagac San Juan Unit 1 (also known as Philippines National Power Plant 1, PNPP-1), officially is scheduled to begin commercial operation in the first quarter of 1985. However, a test run initially scheduled in September 1984 did not take place, and the issuance of an operating license still is pending. The Ministry of Energy had predicted that the Philippines' oil-importing bill would decline from $1.5 billion in 1984 to $1.2 billion in 1985. This is a result of economic slowdown as well as startup of the 600-MWe nuclear plant, a 300-MW coal-fired plant, and two 110-MW geothermal plants.

In anticipation of the nuclear plant operation, the Philippines National Power Corporation remains in the market for purchase of enriched uranium in 1984 and natural uranium in early 1985.

SOUTH KOREA

The Korea Electric Power Corporation (KEPCO) completed the construction of its fourth nuclear plant in 1984, Ko-Ri Unit 5, an 895-MWe PWR designed by Westinghouse (Table 24). The plant, located on the southwest coast of Korea, underwent test runs in January 1984 and is expected to begin commercial operation in March 1985.

However, the recent government program indicates that two units initially scheduled for operation in 1993-1994 may have been delayed for several years. As a result, international bidding for Korea Nuclear Units 11 and 12 may not be initiated before 1986.

Korea also announced its intent to build its own fuel fabrication plant for commercial production in the 1990s, which will be sufficient for KEPCO's planned programs. The plant eventually would be controlled by KEPCO and the Korea Advanced Energy Research Institute (KAERI). KEPCO considered participation by some foreign interests, but later rejected the plan. The plant will be built near Taejon, south of Seoul, with a capacity of 200 MTU per year. The US Export-Import Bank has agreed to provide 85 percent of the financing if a US vendor is awarded the contract for the project.

In general, Korea seeks to increase the degree of autonomy and self-sufficiency in its nuclear program. The Korea Power Engineering Corporation (KOPEC), an engineering subsidiary of KEPCO, is promoting the development of local architect-engineering capability through joint ventures and agreements with overseas companies. KEPCO also manages and partially owns Korea Heavy Industries and Construction (KHIC), and is helping KHIC to localize the construction of all major hardware components by the end of the 1980s. KHIC, as the sole designated Korean manufacturer, is the umbrella licensee to the main supplier companies abroad. KHIC hopes to award subcontracts in the future to smaller Korean companies.

For Korea, 1984 was a year of readjustments in its nuclear power program. Three factors explain the readjustments:

1. The slowdown of economic growth in recent years and the consequent decline in electricity demand growth;
2. The drop in oil prices, which has made less urgent the need to cut dependence on oil;
3. The government's desire to reduce the foreign debt.

Table 24

NUCLEAR POWER UNITS IN SOUTH KOREA

Unit	Plant	MWe	Type	COD[1]	Percent Complete
KNU 1	(Ko-Ri)	556	PWR	4/78	100
KNU 3	(Wolsung)	629	Candu	4/83	100
KNU 2	(Ko-Ri)	605	PWR	7/83	100
KNU 5	(Ko-Ri)	895	PWR	6/85	96
KNU 6	(Ko-Ri)	895	PWR	3/86	88
KNU 7	(Yeonggwang)	900	PWR	12/86	82
KNU 8	(Yeonggwang)	900	PWR	9/87	72
KNU 9	(Ul-Jin)	895	PWR	9/88	37
KNU 10	(Ul-Jin)	895	PWR	9/89	31

[1] Actual or expected Commercial Operation Date

TAIWAN

The Taiwan Power Company (Taipower) increased its number of operating nuclear plants to five in 1984 when the first Maanshan unit began commercial operation (Table 25). Maanshan Unit 1, a 907-MWe pressurized water reactor (PWR) designed by Westinghouse, is located at the southern tip of Taiwan. The second Maanshan unit is scheduled to begin operation in 1985. There were indications in 1984 that Taipower had revived plans to build their seventh and eighth units at a new plant site, Yenliao, scheduled for operation in the early 1990s. Taipower ex-

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pected bid invitations from General Electric, Westinghouse, Combustion Engineering, Framatome and Kraftwerk Union. However, recent political developments indicate that plans have not passed all the levels of approval in Taiwan.

Negotiations for a joint venture agreement between Taipower and Rocky Mountain Energy for an exploration program in the USA also were announced in 1984. The announcement may have been premature because the required government approvals for such an agreement have not been released yet.

Unlike the situation in Korea and Japan, the desire to develop complete domestic nuclear engineering capability has not been pronounced in Taiwan. All of the operating reactors and most of the nuclear technology have come from the USA. However, Taipower has a strong construction division and generally works closely with US architect-engineering firms, notably Ebasco and Bechtel. All of the civil engineering responsibilities are handled by local companies.

Table 25

NUCLEAR POWER UNITS IN TAIWAN

Unit	MWe	Type	COD[1]	Percent Complete
Chin-Shan 1	604	BWR	Dec 1978	100
Chin-Shan 2	604	BWR	Sep 1979	100
Kuosheng 1	951	BWR	Dec 1981	100
Kuosheng 2	951	BWR	Mar 1983	100
Maanshan 1	907	PWR	Jul 1984	100
Maanshan 2	907	PWR	May 1985	95

[1] Actual or expected Commercial Operation Date

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REPUBLIC OF SOUTH AFRICA

Overview

South Africa's gold and uranium operations experienced a relatively prosperous year in 1984 largely because of a favorable rand/dollar exchange rate. Although mines received lower dollar prices for both gold and uranium in 1984, the strength of the US dollar brought about increased rand revenues for producers.

Political difficulties in South Africa were eased somewhat with the March signing of a Non-Aggression Accord with neighboring Mozambique. Contact and trade are taking place despite the opposing economic and political systems. Seen by South Africans as a major foreign policy breakthrough, the Accord has opened the door for a wide-ranging reduction of international confrontation. South African troops are withdrawing from Angola, and peace discussions for Angola and Namibia are proceeding. Nevertheless, South Africa faced increased international opposition to its apartheid policies in 1984. That issue maintains its worldwide prominence and will continue to present obstacles to South African producers' marketing efforts.

Nuclear Power

The Electricity Supply Commission of South Africa (Escom) connected the nation's first commercial nuclear power plant to the electrical grid on April 4, 1984. Koeberg Unit 1, a 922-megawatt PWR, was supplied by the French companies Framatome, Alsthom-Atlantique and Framateg. Framatome announced on August 20 that the unit began commercial operation after receiving authorization from the South African Atomic Energy Corporation at the beginning of August. (The unit was subsequently shut down on January 25, 1985 for cooling pipe inspections.) The French reactor vendor added that Koeberg Unit 1 produced over 1.5 billion kilowatt-hours between April and the end of August. Koeberg Unit 2, also a 922-MW PWR, currently is undergoing power testing, and Nuexco estimates that it will begin commercial operation in late 1985. The Koeberg units are likely to be the only commercial nuclear power plants in South Africa for the rest of the century, as declining growth rates for electricity demand and low coal costs have postponed the need for more nuclear generation.

In February 1984, DOE suspended Escom's two enrichment contracts because of a lingering dispute over nonproliferation safeguards. The US State Department requested the suspension following an announcement by South Africa's Atomic Energy Corporation that it would require safeguards as a condition of exporting nuclear material or technology. Escom has been unable to export enriched product from the USA because of certain provisions in the Nuclear Nonproliferation Act of 1978 which pertain to non-weapons states. The suspension of the contracts allowed South Africa to avoid purchasing enrichment far in excess of its needs, while relieving the US State Department of embarrassment stemming from a possible breach of contract by a US government agency.

Uranium Production and Resources

The South African uranium industry experienced another profitable year, mainly due to favorable currency exchange rates. While mines received lower US dollar prices for uranium and gold, the dramatic depreciation of the rand relative to the dollar resulted in record gold prices in rand terms. Since most of the uranium mined in South Africa is extracted as a by-product or co-product of gold operations, the uranium industry was assured a successful year. Table 26 shows a breakdown of uranium production among the thirteen Chamber of Mines operations in South Africa during 1984. Palabora Mining Company (PMC) is not a Chamber of Mines member. Total production in 1984 of 14,531,000 pounds U_3O_8 was five percent less than 1983. Eight producers experienced declines in production totalling approximately 1.2 million pounds, over 60 percent of which was attributed to Harmony, JMS, and Beisa. This decline was partially offset by increases in production by three producers amounting to approximately 450 thousand pounds. Randfontein and Vaal Reefs contributed 90 percent of the increase.

Palabora Mining Company announced in its annual report to shareholders that it sold 502 thousand pounds of uranium concentrates in 1984. This represents a 29-percent increase from the 356 thousand pounds sold in 1983. PMC has not yet released exact production figures.

NUCOR (the Nuclear Development Corporation of South Africa) in August released an updated official assessment of South Africa uranium resources and production capabilities. The report included the latest official evaluation of trends in uranium prospecting, production and prices, as well as discussions of geology and national policy matters.

NUCOR estimated that total Reasonably Assured Resources (RAR) and Estimated Additional Resources (EAR) recoverable for less than $130 per KgU declined

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13.4 percent compared to the 1981 assessment. NUCOR also concluded that 1983 South Africa production rose 4.2 percent from 1981 production figures. (The NUCOR report is examined in greater detail in Report 193, September 1984.) Other findings included the following:

1. South Africa supplied 14 percent of the free world's uranium in 1983.

2. The country also holds 14 percent of the free world's resources.

3. The Witwatersrand quartz-pebble conglomerates are the basis of 97 percent of South Africa's production; the Palabora project produces the remaining three percent as a by-product of copper mining.

Specific Comments on Production Operations

Beisa (St. Helena). Total production fell 21 percent in preparation for the cessation of operations scheduled for late 1984. Third and fourth quarter production amounted to only 37 percent of the first and second quarter levels. General Mining Union Corporation Limited (Gencor) and St. Helena Gold Mines Limited announced on May 1 their intention to shut down the mine in late 1984 because of sharply increasing losses. Beisa had been unprofitable since production began in 1982. Because of a lower than expected recovery grade, St. Helena purchased uranium from other sources in order to meet contractual obligations. NUFCOR (Nuclear Fuels Corporation of South Africa [Proprietary] Limited) has agreed in principle to accept assignment of all obligations under the 1978 uranium supply agreement. Proceeds from the sale of assets are expected to cover the major portion of liabilities relating to the mine. Because profitable operation of the mine is unlikely in the near future, it was not placed on a care and maintenance basis, but was completely shut down. Being a primary uranium producer with gold as a by-product, Beisa had not been able to rely on gold operations to remain profitable. Its demise will reduce South Africa's annual production rate by approximately 1,000,000 pounds U_3O_8.

Blyvooruitzicht. This relatively high-cost producer

Table 26

REPUBLIC OF SOUTH AFRICA:
1984 URANIUM PRODUCTION[1]
(Thousands of pounds U_3O_8)

Operation	First Quarter 1984	Second Quarter 1984	Third Quarter 1984	Fourth Quarter 1984	Total 1984 Production
Beisa (St. Helena)[2]	338	333	107	16	794
Blyvooruitzicht	155	132	142	85	514
Buffelsfontein	313	331	337	371	1,352
Chemwes (Stilfontein)	310	279	290	276	1,155
Dreifontein Consolidated	98	104	88	61	351
ERGO[3]	113	94	71	84	362
Harmony	307	259	274	255	1,095
Hartebeestfontein	248	253	225	237	963
JMS[4]	356	265	293	402	1,316
Randfontein	287	361	361	297	1,306
Vaal Reefs	1,069	1,129	1,078	1,052	4,328
Western Areas	175	171	164	163	673
Western Deep Levels	79	82	83	78	322
TOTAL	3,848	3,793	3,513	3,377	14,531

[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.
[2] Mining operations ceased and underground reclamation completed.
[3] ERGO = East Rand Gold and Uranium Co. Ltd.
[4] JMS = Free State Joint Metallurgical Scheme.

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ceased uranium production on November 23, 1984. Production fell 18 percent from the 1983 figure, but the processed stockpile was sufficient to fulfill all outstanding contracts.

Buffelsfontein. No change in production in 1984 for this high-grade producer.

Chemwes (Stilfontein). Stilfontein Gold Mining Ltd. is the parent company (holding an 80-percent share) of Chemwes, which produced seven percent less U_3O_8 in 1984 due to a continued decline in yield as higher-grade slimes become depleted.

Driefontein. Production fell nine percent due to lower grade ore recovery and decreased throughput.

East Rand Gold and Uranium Co. Ltd. (ERGO). This company retreats old slimes (tailings) dams in the East Rand. A 29-percent drop in production was attributed to the continued decline in uranium grades of slimes material treated.

Harmony. Production fell 20 percent in 1984, mainly due to a plant closure. The company announced on March 12 that it had decided to discontinue production at the Merriespruit uranium recovery plant. The plant, commissioned in 1980 and one of three that Harmony operates, accounted for approximately 28 percent of Harmony's total uranium production. According to the company announcement, production from the other two plants, together with existing stockpiles, is sufficient to meet long-term committed sales. The shutdown of the Merriespruit plant will result in savings in operating costs and therefore, small improvements in profits. Harmony Chairman C. G. Knobbs cited low uranium prices as the reason for the closure, stating, "the company's role as a uranium producer was reassessed during the year in light of the depressed market conditions that are likely to prevail for some time to come."

Hartebeestfontein. Production remained constant in 1984 for this rich mine.

Free State Joint Metallurgical Scheme (JMS). Although fourth quarter production rose sharply, overall 1984 production dropped 17 percent. This decline was attributed to changes to the feed mix implemented in 1983 as well as decreased amounts of slimes and flotation concentrates treated.

Randfontein. Production increased 21 percent during 1984, largely because of expansions and modifications to the Cooke uranium plant. The plant currently is treating ore from the No. 1 and No. 2 shafts, but as treatment expands at the No. 3 shaft, it will replace ore from the low-grade No. 1 shaft. Thus, output is expected to increase further in the future.

Vaal Reefs. The Vaal Reefs/Southvaal complex (Figure 6) is the largest producer in South Africa. 1984 pro-

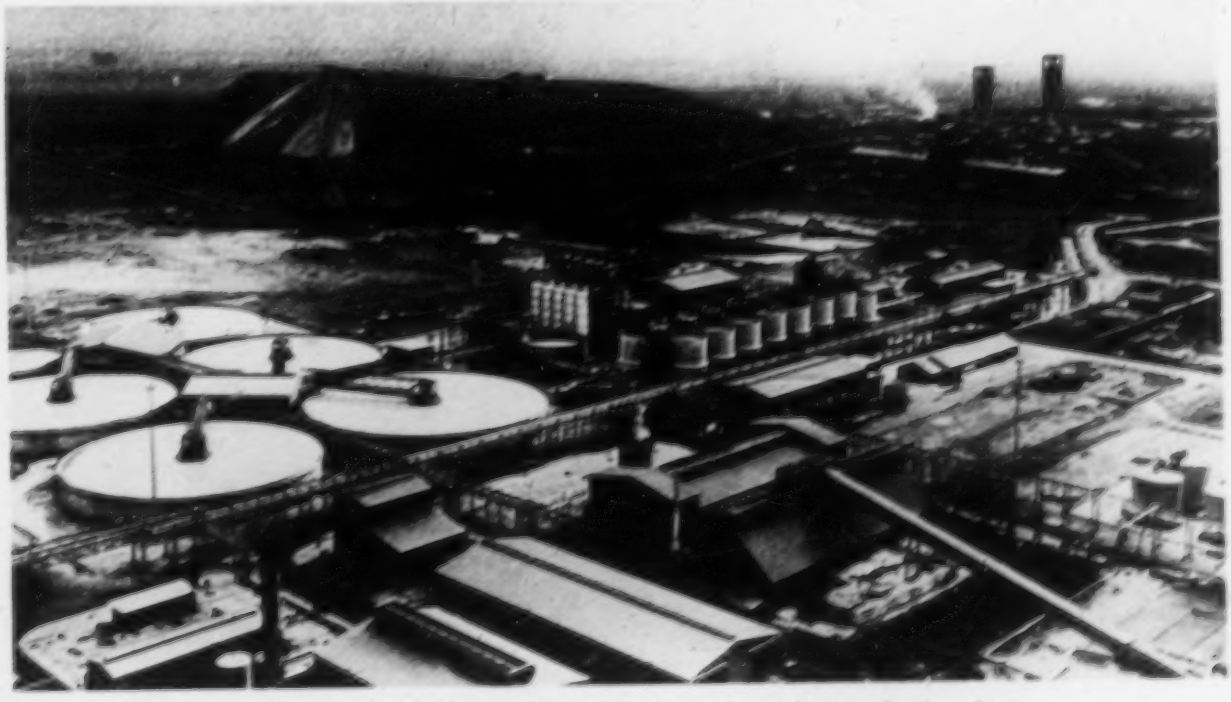

Figure 6. Aerial view of the Vaal Reefs South uranium production plant.

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duction increased five percent, which coincides with the planned level for the year. The rise is attributed to an increased contribution of tonnage from the richer south lease area.

Western Areas. Production increased eight percent in accordance with plans to expand production from the uranium-rich Middle Elsburg Reef. Although low in gold content, combined gold and uranium production from these reefs should remain profitable at gold grades exceeding 1.3 grams per ton. The company also has planned a greater utilization of plant capacity for uranium in order to meet additional contractual commitments negotiated in 1983. These commitments require additional uranium oxide production of approximately 130,000 pounds U_3O_8 in each of the next three years.

Western Deep Levels. Production fell 16 percent in 1984, as the company decided in early 1984 to cease uranium production in early 1985. The company plans to meet existing contracts from stockpiles and other arrangements. This closure will reduce South Africa's annual output by approximately 400,000 pounds U_3O_8. The board of directors of the company approved a proposal to convert a portion of the uranium plant into a gold treatment facility. The estimated escalated cost to completion is R35 million, with a target commissioning date of July 1985.

NAMIBIA

Rossing, the largest open-pit uranium mine in the world, is the sole source of uranium production in Namibia. Exact production figures have not been released, but Nuexco estimates that 1984 production declined to approximately nine million pounds U_3O_8. Nuexco's forecast indicates Rossing output will decline further in 1985, to approximately 8.5 million pounds, and remain at that level for some time. For a detailed analysis of the development, operations and geology of the Rossing project, see the two-part article in Reports 188 and 189 (April and May, 1984).

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UNITED STATES

Introduction

The US nuclear industry suffered further deterioration during 1984. Selling of excess inventories by utilities and non-producing entities continued throughout the year. Continued worldwide over-production and uncertainties surrounding the new Utility Services enrichment contract (USEC) fueled the debate over the viability of the US mining industry. Depressed U_3O_8 prices gave way to still lower US production levels for the fourth consecutive year, as several production facilities were shut down and many others reduced output. The first months of 1985 have shown no signs of market recovery.

Nuclear Power Developments

If there was a bright spot in the US nuclear industry during 1984, it was the progress utilities achieved in moving reactors toward commercial operation. During 1984, five reactors representing a total capacity of 5,258 MWe began commercial operation. Table 27 summarizes the licensing progress of US nuclear units during 1984. Four full-power licenses were issued in 1984, adding 4,534 MWe to the US nuclear generating capacity. The Nuclear Regulatory Commission granted five fuel-loading and low-power testing licenses, representing a total capacity of 5,694. Nuexco expects those five units will be licensed for full power in early 1985. Finally, one plant received a fuel-loading and cold-testing license. In addition, Diablo Canyon Unit 1, in a historic development, was restarted after meeting seismic upgrading standards. It is scheduled to begin commercial operation in mid-1985. Nuexco estimates fourteen reactors will begin commercial operation in 1985, while three more will receive full-power licenses (Table 28).

Table 27

US NUCLEAR UNITS' LICENSING PROGRESS DURING 1984

Unit	Utility	MWe Net	Type
Commercial Operation			
LaSalle 2	Commonwealth Edison	1078	BWR
McGuire 2	Duke Power Co.	1180	PWR
San Onofre 3	Southern Calif. Edison	1080	PWR
Summer	South Carolina Elec. & Gas	900	PWR
WNP 2	Washington PPSS	1100	BWR
Total		5,258	
Full-Power License			
Grand Gulf 1	Middle South Utilities	1250	BWR
Diablo Canyon 1	Pacific Gas & Electric	1084	PWR
Susquehanna 2	Pennsylvania P&L	1050	BWR
Callaway	Union Electric	1150	PWR
Total		4,534	
Fuel-Loading and Low-Power-Testing License			
Palo Verde 1	Arizona Public Service	1270	PWR
Byron 1	Commonwealth Edison	1120	PWR
Catawba 1	Duke Power Co.	1145	PWR
Waterford	Middle South Utilities	1104	PWR
Limerick 1	Philadelphia Electric	1055	BWR
Total		5,694	
Fuel-Loading and Cold-Testing License			
Shoreham[1]	Long Island Lighting	820	BWR
Total		820	

[1]License revoked by the Atomic Safety and Licensing Board in early 1985.

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NUEXCO

UNITED STATES

Construction delays and financial difficulties again were prominent in 1984 (Table 29). Eight reactors were canceled outright, representing a total generating capacity of 9,046 MWe. This figure represents 114 percent of the total capacity canceled in 1983 and 41 percent of the capacity canceled in 1982. Consumers Power Company effectively canceled its two Midland reactors, and official cancellation in the near term is probable. Finally, one reactor was indefinitely suspended.

Nuexco forecasts indicate that at least eight more reactors currently under construction or on order will be canceled. Those imminent cancellations represent approximately 9,500 MWe and approximately 3.5 million pounds U_3O_8 in unneeded average annual consumption for the units. Table 30 lists US reactor construction status in descending order of completion percentage as of December 31, 1984.

Table 28

US NUCLEAR UNITS NEARING COMPLETION IN 1985

Unit	Utility	MWe Net	Type
Expecting Commercial Operation			
Palo Verde 1	Arizona Public Service	1270	PWR
Byron 1	Commonwealth Edison	1120	PWR
Fermi 2	Detroit Edison	1100	BWR
Catawba 1	Duke Power Co.	1145	PWR
Wolf Creek	Kansas Gas & Electric	1150	PWR
Grand Gulf 1	Middle South Utilities	1250	BWR
Waterford	Middle South Utilities	1104	PWR
Limerick 1	Philadelphia Electric	1055	BWR
Diablo Canyon 1	Pacific Gas & Electric	1084	PWR
Diablo Canyon 2	Pacific Gas & Electric	1106	PWR
Susquehanna 2	Pennsylvania P&L	1050	BWR
Comanche Peak 1	Texas Utilities	1150	PWR
Watts Bar 1	Tennessee Valley Auth.	1177	PWR
Callaway 1	Union Electric	1150	PWR
Total		15,911	
Expecting Full-Power License			
Palo Verde 2	Arizona Public Service	1270	PWR
Perry 1	Cleveland Electric	1205	BWR
River Bend 1	Gulf States Utilities	940	BWR
Total		3,415	

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Table 29

US NUCLEAR UNITS CANCELED OR RESTARTED IN 1984

Unit	Utility	MWe Net	Type
Canceled			
Zimmer	Cincinnati G&E	810	BWR
River Bend 2	Gulf States Utilities	940	BWR
Marble Hill 1	Public Service Indiana	1130	PWR
Marble Hill 2	Public Service Indiana	1130	PWR
Hartsville A1	Tennessee Valley Auth.	1233	BWR
Hartsville A2	Tennessee Valley Auth.	1233	BWR
Yellow Creek 1	Tennessee Valley Auth.	1285	PWR
Yellow Creek 2	Tennessee Valley Auth.	1285	PWR
Total		9,646	
Effectively Canceled			
Midland 1	Consumers Power	530	PWR
Midland 2	Consumers Power	805	PWR
Total		1,335	
Indefinitely Suspended			
Seabrook 2	PS New Hampshire	1150	PWR
Total		1,150	
Restarted			
San Onofre 1	Southern Calif. Edison	436	PWR
Total		436	

Production

Nuexco estimates US production for 1984 at 15.6 million pounds U_3O_8, down 26 percent from 1983 production (21.2 million pounds). 1983 production fell 21 percent from the 26.8 million pounds produced in 1982. Table 31 summarizes the regional distribution of US production in 1984.

Six production facilities representing a total annual production capacity of approximately ten million pounds U_3O_8 announced plans to either cut back or shut down (Table 32). In addition, Kerr-McGee announced in January 1985 that its Quivira Mining Company will shut down indefinitely its mine and mill operations in McKinley County, New Mexico. The mill has an annual production capacity of approximately seven million pounds U_3O_8.

Most of these producers are not expected to attempt mine startups in the foreseeable future, unless an unanticipated rise in market price occurs. Non-US entities continued to penetrate the US market, gaining market share in 1984 by means of spot and long-term U_3O_8 and UF_6 sales. Unconventional and in-situ producers in the US remained active and competitive throughout the year. Solution mining in the South Texas district and phosphoric acid production in Florida and Louisiana accounted for almost 35 percent of the 1984 output. Conventional production owners continued to curtail activities during the year. Three milling operations closed down for six or more months, and several other projects were put on temporary stand-by, announcing intent to resume operations as the market recovers.

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Table 30

US NUCLEAR UNITS UNDER CONSTRUCTION AND ON ORDER

Unit	Utility	MWe (net)	Type	Percent Complete	COD[1]
Callaway 1	Union Electric	1150	PWR	100	Mar 1985
Grand Gulf 1	Middle South	1250	BWR	100	Mar 1985
Diablo Canyon 1	Pacific G&E	1084	PWR	100	May 1985
Waterford 3	Louisiana P&L	1104	PWR	100	Jun 1985
Fermi 2	Detroit Edison	1100	BWR	100	Jun 1985
Limerick 1	Philadelphia Elec	1055	BWR	100	Sep 1985
Shoreham	Long Island Lighting	820	BWR	100	Oct 1985
Palo Verde 1	Arizona PS	1270	PWR	100	late 1985
Palo Verde 2	Arizona PS	1270	PWR	99	mid-1986
Wolf Creek	Kansas G&E	1150	PWR	99	May 1985
Comanche Peak 1	Texas Utilities	1150	PWR	99	Dec 1985
Catawba 1	Duke Power	1145	PWR	99	Jun 1985
Diablo Canyon 2	Pacific G&E	1106	PWR	99	Jul 1985
Watts Bar 1	TVA	1177	PWR	99	Oct 1985
Byron 1	Commonwealth Edison	1120	PWR	97	Feb 1985
Perry 1	Cleveland Electric	1205	BWR	97	Dec 1985
Palo Verde 3	Arizona PS	1270	PWR	95	mid-1987
Hope Creek 1	Public Service E&G	1170	BWR	94	Dec 1986
River Bend 1	Gulf States Utilities	940	BWR	93	Dec 1985
Millstone 3	Northeast Utilities	1150	PWR	92	May 1986
Shearon Harris 1	Carolina P&L	900	PWR	90	Sep 1986
Clinton 1	Illinois Power	933	BWR	89	Jul 1986
Nine Mile Pt. 2	Niagara Mohawk	1080	BWR	85	Oct 1986
Catawba	Duke Power	1145	PWR	84	Jun 1987
Beaver Valley 2	Duquesne	833	PWR	83	Oct 1986
Bellefonte 1	TVA	1213	PWR	81	Apr 1989
Seabrook 1	New Hampshire Yankee	1150	PWR	80	Aug 1986
Braidwood 1	Commonwealth Edison	1120	PWR	80	Oct 1986
WNP 3	WPPSS[2]	1240	PWR	75	indefinite
Vogtle 1	Georgia Power	1100	PWR	73	Mar 1987
South Texas 1	Houston L&P	1250	PWR	72	Jun 1987
Watts Bar 2	TVA	1177	PWR	68	Apr 1988
Byron 2	Commonwealth Edison	1120	PWR	67	Oct 1986
Comanche Peak 2	Texas Utilities	1150	PWR	65	Dec 1988
WNP 1	WPPSS	1250	PWR	63	indefinite
Bellefonte 2	TVA	1213	PWR	54	Apr 1991
Braidwood 2	Commonwealth Edison	1120	PWR	54	Dec 1987
Vogtle 2	Georgia Power	1100	PWR	50	Sep 1988
Perry 2	Cleveland Electric	1205	BWR	44	indefinite
South Texas 2	Houston L&P	1250	PWR	43	Jun 1989
Grand Gulf 2	Middle South	1250	BWR	33	indefinite
Limerick 2	Philadelphia Elec	1055	BWR	31	Oct 1988
Seabrook 2	New Hampshire Yankee	1150	PWR	23	indefinite
Carroll County 1	Commonwealth Edison	1120	PWR	0	2001
Carroll County 2	Commonwealth Edison	1120	PWR	0	2002

[1]Commercial Operating Date, based on published information and utility forecasts.
[2]WPPSS = Washington Public Power Supply System.

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Table 31

1984 US URANIUM PRODUCTION BY STATE
(Millions of pounds U_3O_8)[1]

Mill Location	1984	Percent of Total 1984 Production
New Mexico	3.0	19
Wyoming	3.7	24
Texas	2.8	18
Utah	1.3	8
Others[2]	4.8	31
Total	15.6	100

[1]Nuexco estimates.
[2]Includes Arizona, Colorado, Florida, Louisiana, Nebraska and Washington.

Legislation Regarding Uranium

In January 1984, the Department of Energy (DOE) issued the new Utility Services enrichment contract (USEC) and most DOE customers converted by the October 1, 1984 deadline. The introduction of this contract has had far-reaching effects on utility demand and consumption forecasts for natural uranium.

The production sector has felt the broadening effects of the USEC as it influences utility procurement and inventory strategies for nuclear fuel. In December, three US producers filed a five-count civil action suit in the US District Court of Colorado against the DOE, DOE Secretary Donald Hodel and other DOE officials, claiming that:

1. DOE is obligated to limit enrichment of foreign uranium for domestic use so as to maintain a viable domestic uranium industry.
2. DOE unlawfully submitted the USEC and therefore it should be invalidated.
3. DOE should not be allowed to fix the transaction tails assay because it would restrict domestic uranium demand.
4. DOE should be precluded from any further sales of uranium from the government stockpile (through the split tails or pre-produced inventory policies) until a viable domestic uranium industry is assured.
5. DOE is required to adopt regulations which would restore the domestic industry's viability.

Shortly after the producers filed their suit, the Congressional General Accounting Office (GAO) issued a report which admonished DOE for violating the Administrative Procedures Act (APA) by issuing the USEC before assessing the ramifications of the contract on the mining indus-

Table 32

US URANIUM OPERATIONS SHUT DOWN OR CURTAILED IN 1984

Company	Annual Capacity[1] (Thousands of pounds U_3O_8)	Event
Atlas Corporation	2,000	Closed the Velvet, Pandora and Rim mines in February; closed the mill in March.
Tenneco	200	Suspended production at West Cole solution mine, Hebbronville, Texas.
Union Carbide Corp.	2,800	Shut down Gas Hills, Wyoming mine and mill and Uravan, Colorado mine and mill.
Western Nuclear	1,000	Closed the Sherwood, Washington mine and mill. (Plans to reopen in 1985.)
[illegible]stake Mining	3,800	Placed its Grants, New Mexico mill on standby. (Was reopened in January 1985.)
Everest Minerals	250	Shut down the Las Palmas, Texas operation.
Total	10,050	

[1]Annual capacity of the referenced operations only.

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try. It is difficult to predict the effects these accusations will have, or a possible outcome. Nevertheless, the surrounding controversy represents an attempt to force DOE to reexamine the fundamental purpose for which the USEC was created.

Outlook

Although US production has fallen at a steady rate throughout the past few years, non-US producers' capabilities at the lower price production levels continue to soar. This factor, coupled with USEC-reduced uranium consumption projections, implies the continuation of a buyer's market and depressed spot prices for the next three to five years.

Exploration and Development

Uranium exploration and mining activities decreased steadily throughout 1984 as the market for uranium concentrates continued the downward trend that began during the last quarter of 1983. Exploration and development drilling activity declined as expected based on an active rig count. Nuexco estimates total drilling at 2.0 to 2.5 million feet as compared to DOE's estimate of 3.5 million feet for 1983. (*Note:* DOE no longer collects drilling and ore reserve information related to the uranium resource industry.) Nuexco's estimate is based on information supplied by a survey of selected companies.

Exploration drilling by at least six companies in the South Texas district averaged seven working rigs per month throughout the year; development drilling averaged six rigs per month.[1] Throughout Arizona, Colorado, Nebraska, New Mexico, Utah and Wyoming, at least 13 companies participated in drilling, with an average monthly rig count of 14 for exploration drilling and seven for development drilling. In the Grants, New Mexico district, for many years the most active district in the USA, there was no exploration drilling for eight months of the year, but one to four companies drilled during August to fulfill annual property requirements; development drilling was limited to nine months with one to three rigs.

Active Projects

Exploration activity in the South Texas district continued along known geologically favorable trends located primarily in Duval, Brooks and Kleberg counties. The favored targets were fine to coarse sand and conglomerate units of the Goliad Formation. Further north in Live Oak and Bee counties, the main target remains the Oakville Sandstone. There were no significant discoveries announced in 1984; however, development drilling in certain areas proved successful in delineating additional reserves and enhancing certain active solution-mining operations.

The area north and south of Grand Canyon National Park experienced a slight surge in activity. Five or six major uranium companies continued to acquire new ground for exploration, including geophysical and drilling programs. The exploration target is potentially high-grade deposits in breccia pipe structures common to the district. In addition, another eight to ten small exploration companies and independent operators competed for the more favorable exploration targets. Constructive exploration was limited primarily to annual work requirements related to conditions of property acquisition.

Energy Fuels Ltd. (EFL) remains the most aggressive and successful operator in the district. EFL presently is mining three highly mineralized breccia pipe deposits and is developing a fourth scheduled for production sometime in late 1987 or early 1988. In addition, EFL has applied to federal and state agencies with the intent of developing yet another deposit. The proposed project site is the Canyon pipe located on the south side of the Grand Canyon. If the project proceeds, it will be the first uranium mining in the southern rim district since the Orphan pipe was last mined in 1969.

Ferret Exploration Company continued to explore its Big Red property in Dawes and Box Butte counties of Nebraska. The mineral trend at the large Crow Butte deposit has been traced for several miles south onto the Big Red property. Ferret remains optimistic about property potential as a result of the important uranium resources identified to date.

Development of the Crow Butte project (owned 50 percent by Wyoming Fuel Company and 50 percent by Ferret) has been delayed by the permitting process. The joint venture anticipates licensing and permitting requirements will be in place in early 1985 and construction of a solution-mine pilot plant should begin by mid-to-late 1985.

Everest Minerals Corp. is continuing project feasibility studies on its Highland property located in South Powder River Basin, Wyoming. Everest has announced its intent to develop a solution mine on the property, probably during the second half of 1986. The ore deposit is a down-dip westward extension of Exxon's open pit, which closed in March 1984. Events that further affected the US uranium industry in 1984 are listed chronologically in Table 6, page 20, Report 198 (February 1985).

[1] It should be noted that by Nuexco estimate, drilling time per rig varies from 5 to 25 days per month and may average less than 10 working days per rig; thus, footage drilled was held below normal capabilities.

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